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WAR MACHINE

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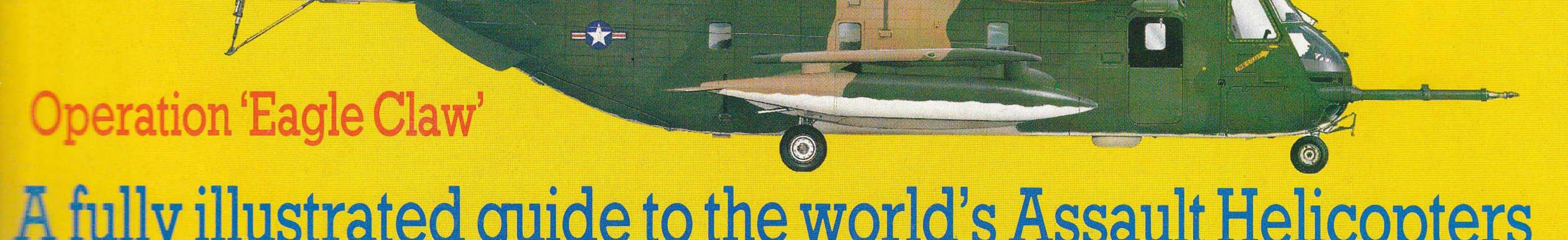
Sikorsky CH-53 in Action

Assault on Grenada

Armed Forces of the World:

US Navy (Part 3)



Operation 'Eagle Claw'

A fully illustrated guide to the world's Assault Helicopters

WAR MACHINE

Volume 3 **Issue 36**

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Armed Forces of the World

US Navy (Part 3) iii

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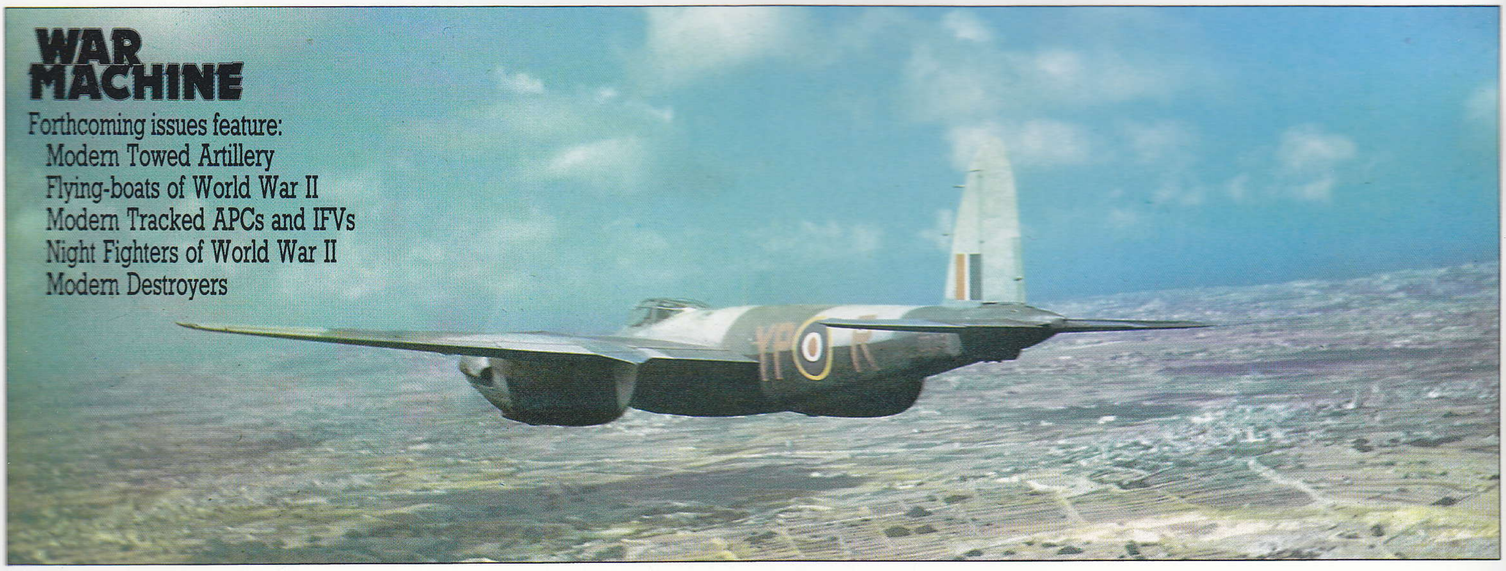
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Assault Helicopters

The assault helicopter is perhaps the most useful and versatile type of aircraft available to an air arm of any size. Despite being less glamorous than supersonic fighters, and less available in 'hand-me-down' gifts from the major powers, assault helicopters are found in the inventories of almost every air force and have seen service in every conflict since Malaya and Vietnam.

Assault helicopters were first used by the Royal Air Force in Malaya. Here a Westland Whirlwind HAR.Mk 4 of No. 155 Squadron drops an infantry patrol in a remote jungle clearing.

Despite the fact that development of the helicopter can be traced back some 50 years to the advent of the autogyro, it is only in the past 20 years or so that the helicopter has gained widespread acceptance as a weapon of war.

Capable of operation virtually anywhere in the world, the helicopter is a truly remarkable flying machine, and it would be fair to say that its impact on the conduct of war has been no less dramatic than that of fixed-wing aircraft. But it was not always thus, and indeed there were many who questioned the very validity of the concept. Vietnam, the availability of turbine power and the immortal 'Huey' changed all that, and no self-respecting air force, navy or army would now be without a complement of these highly versatile machines.

Today, helicopters routinely undertake a multiplicity of missions ranging from anti-submarine warfare through airborne early warning to electronic combat. Perhaps the most important single mission, however, is that of assault and assault support, for the helicopter can truly lay claim to have liberated the foot soldier. No longer is it necessary for the humble 'grunt' to march for hours or days before taking up arms: today he can travel rapidly to the combat zone, arriving fresh and ready to do battle. Similarly, artillery support can be deployed rapidly to virtually any location at which it is urgently needed. And in the event of the fortunes of war proving unkind, it is possible to evacuate personnel and equipment in short order, thus enabling them to fight another battle on another day.

To use the modern military vernacular, the helicopter, be it large like the Sikorsky CH-53E Super Stallion or small like the Bell OH-58 Kiowa, can truly be said to be a force multiplier.

A South African Air Force Puma from No. 19 Sqn, based at Swartkop, edges towards a rocky outcrop in the Drakensberg mountains. South African Pumas have been used extensively on operations in Angola and Namibia.

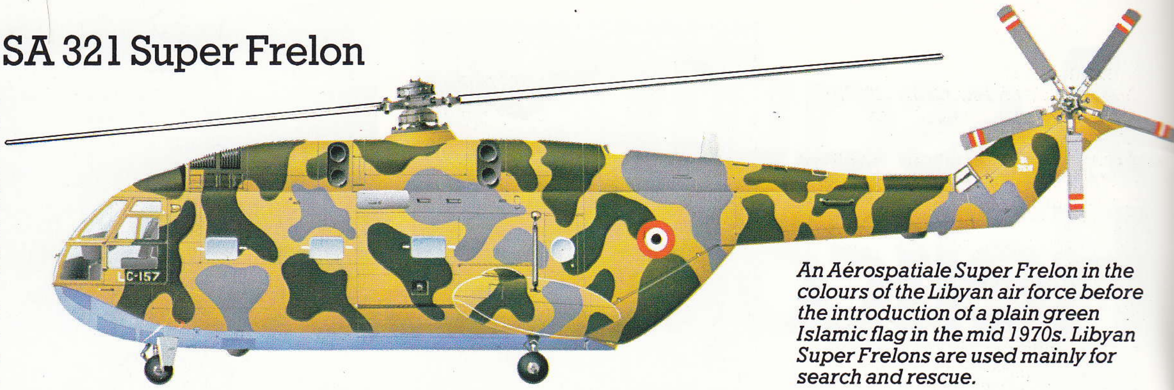
FRANCE

Aérospatiale SA 321 Super Frelon

A development of the original **Sud-Aviation SA 3200 Frelon** (hornet) medium-transport helicopter which flew for the first time during June 1959, the **Aérospatiale SA 321 Super Frelon** holds the distinction of being the largest European-designed helicopter yet to attain quantity production, and is presently in service with several of the world's air arms.

A number of variants have appeared to date, optimized for a variety of missions ranging from anti-submarine warfare through conventional transport to assault duty, and the type has seen some combat action, most notably with Israel's Heyl Ha'Avir which employed the type in the commando raid on Beirut airport several years ago.

Initially designated **SA 3210**, two prototypes were built (one troop transport model and one for maritime applications), these making their respective maiden flights in December 1962 and May 1963. Four pre-production **SA 321** helicopters followed them down the Marignane line before examples of the **SA 321G** ASW model for France's Aéronavale began to appear in the last quarter of 1965, these subsequently entering service during the course of 1966. Designed for operation from the often cramped confines of aircraft-carriers, the SA 321G has a folding tail section to assist in stowage and incorporates Sylphe panoramic radar in the outrigger floats, dunking sonar equipment and provision for the carriage of up to four homing torpedoes.



An Aérospatiale Super Frelon in the colours of the Libyan air force before the introduction of a plain green Islamic flag in the mid 1970s. Libyan Super Frelons are used mainly for search and rescue.

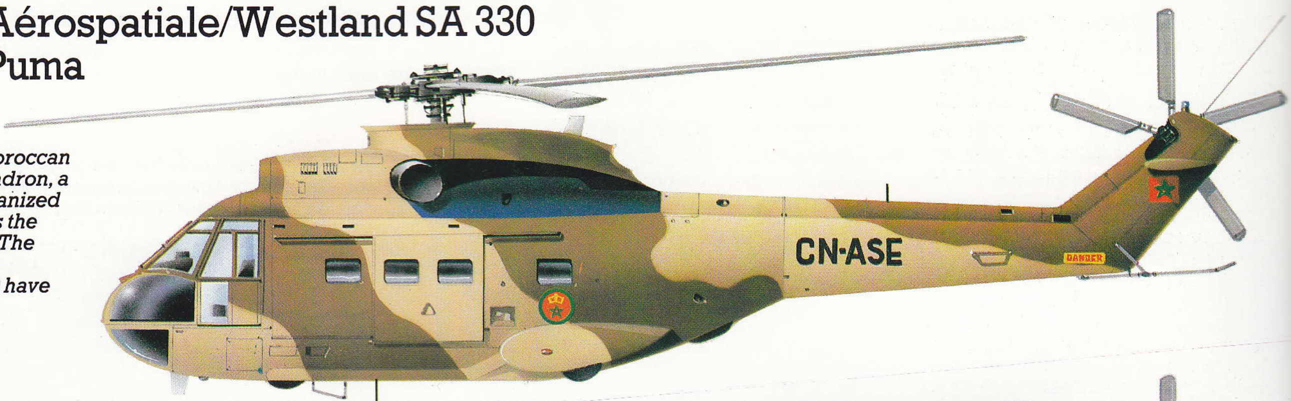
In addition to the maritime version produced for France, the Super Frelon has also appeared in civil guise but failed to secure any substantial orders. However, it has achieved some success in the export market, Israel being one of the first customers when it ordered the **SA 321K** for military transport duties. Delivery of these began in 1967, and the type has since proved its worth in airborne assault missions on several occasions. Lacking the amphibious qualities of the SA 321G, the SA 321K is essentially a military variant of the SA 321J; another derivative of this type is the **SA 321L**, which is in widespread service with the South African Air Force, another air arm which has used the Super Frelon in combat on numerous occasions. Another subtype is the **SA 321M** operated by Libya in dual ASW/search-and-rescue tasks, whilst further customers include China and Iran.

Specification

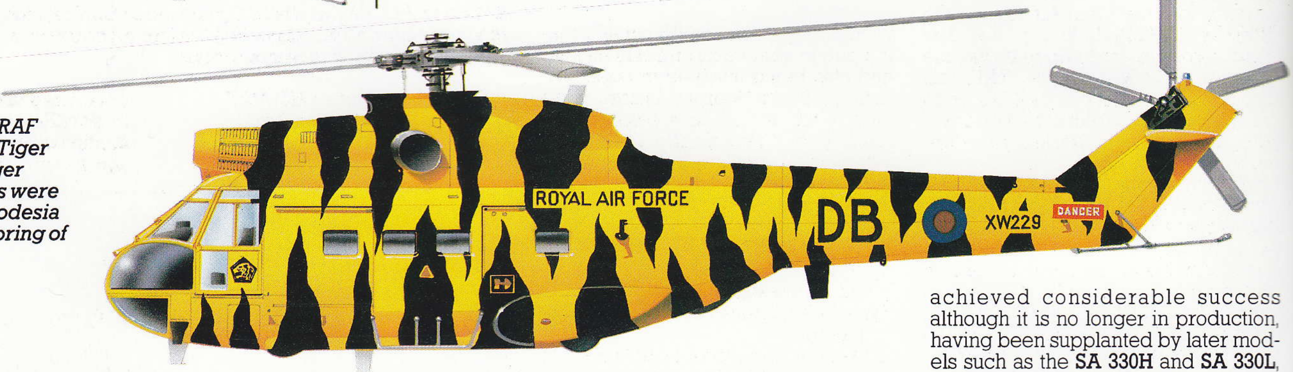
Aérospatiale SA 321G Super Frelon
Type: ASW helicopter
Armament: four homing torpedoes
Powerplant: three Turboméca IIIC-6 turboshafts each rated at 1,550 shp (1156 kW); (SA 321K) 1,870 shp (1394 kW) GE T58-10 engines
Performance: maximum speed at sea level 275 km/h (171 mph); cruising speed at sea level 250 km/h (155 mph); service ceiling 3150 m (10,325 ft); normal range at sea level 820 km (509 miles)
Weights: empty 670 kg (14,771 lb); maximum take-off 13000 kg (28,660 lb)
Dimensions: main rotor diameter 18.90 (62 ft 0 in); length of fuselage 19.40 m (63 ft 7¾ in); height at tail rotor 6.65 m (21 ft 10 in); main rotor disc area 280.55 m² (3,020 sq ft)

FRANCE/UK

Aérospatiale/Westland SA 330 Puma



A Puma of the Royal Moroccan Gendarmerie Air Squadron, a paramilitary force organized along the same lines as the French Gendarmerie. The Puma has been widely exported and over 600 have been built.



A Puma of No. 230 Sqn RAF garishly painted with 'Tiger Stripes' for a NATO Tiger Meet. The RAF's Pumas were used extensively in Rhodesia during Britain's monitoring of the elections and the ceasefire.

Without doubt one of the more successful examples of Anglo-French collaboration, the **Aérospatiale/Westland SA 330 Puma** has been in quantity production for more than 15 years and is in widespread use throughout the world, serving with close to 40 air arms plus many civilian concerns.

Originally conceived by Sud-Aviation in response to a French army (ALAT) requirement for an all-weather/all-climate medium tactical helicopter capable of carrying 16 troops or freight, the SA 330 prototype was still in the process of manufacture when, in 1967, it was selected to fulfil the Royal Air Force's Tactical Transport Programme, subsequently becoming the subject of a joint production agreement between Aérospatiale in France in Westland Helicopters in the United Kingdom. Coincidental with this decision, an order was placed for 40 **Puma HC.Mk 1** helicopters for the RAF.

Two prototypes and six pre-production specimens were built in all, the first of these making a succesful maiden flight in mid-April 1968. The first production example of the **SA 330B** for ALAT took to the air in September 1968, with deliveries beginning fairly soon after that, in March 1969, although the variant did not attain full operational status until June 1970. By then, the last pre-production machine had been modified to RAF configuration and this was joined by the first Westland-built **SA 330E** in the trials programme on 25 November 1970. Deliveries to the RAF got under way in 1971, initially to No. 240 Operational Conversion Unit and later in the year to No. 33 Squadron, both being based at Odiham.

In addition to these two customers, the Puma soon found favour overseas, the initial export model being the **SA 330C**. Based on the SA 330B, this achieved considerable success although it is no longer in production, having been supplanted by later models such as the **SA 330H** and **SA 330L**, both of which incorporate improvements arising from early operational experience, which indicated a need for additional power.

Production of the Puma was originally centred on Yeovil and Marignane, but licence production and assembly agreements have since been reached with ICA in Romania, with Nurtanio in Indonesia and with Helibras in Brazil, while a more recent development, the **AS 332 Super Puma**, first flew in September 1978, this featuring different and more powerful engines, composite rotor blades, single-wheel main landing gear units and full de-icing equipment.

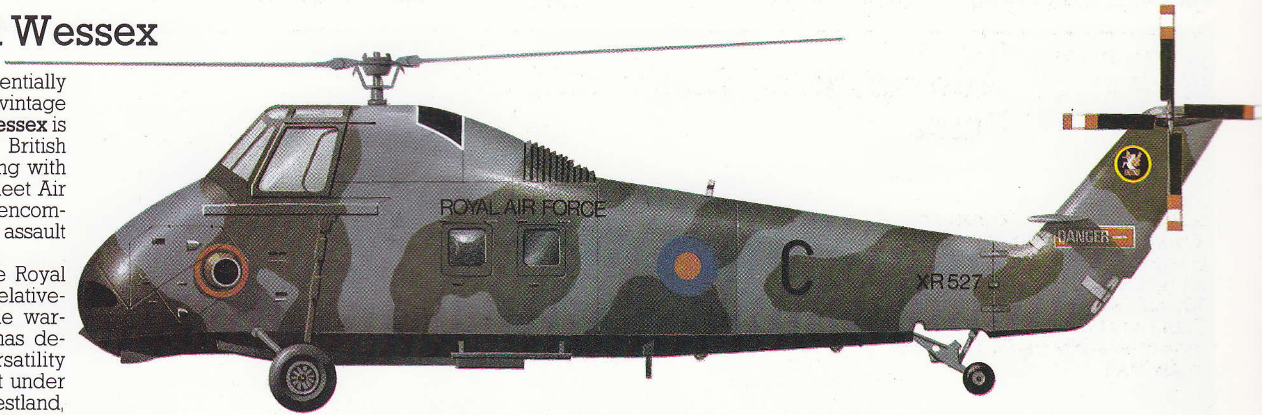
Specification

Aérospatiale/Westland SA 330L Puma
Type: medium transport/assault helicopter
Armament: a wide diversity of cannon, machine-guns, rockets and missiles can be carried
Powerplant: two Turboméca Turmo IVC turboshafts each rated at 1,575 shp (1174 kW)
Performance: maximum permissible speed 293 km/h (182 mph); maximum cruising speed 271 km/h (168 mph); service ceiling 6000 m (19,685 ft); maximum range at normal cruise speed 572 km (355 miles)
Weights: empty 3615 kg (7970 lb); maximum take-off 7400 kg (16,315 lb)
Dimensions: diameter of main rotor 15.00 m (49 ft 2½ in); length 18.15 m (59 ft 6½ in); height 5.14 m (16 ft 10½ in); main rotor disc area 176.71 m^2 (1,902.2 sq ft)

The pilot of this No. 33 Sqn Puma indulges in some low flying along a river in Belize. The squadron, normally based at Odiham, keeps a detachment in Belize in support of British ground forces who deter expansion by neighbouring Guatemala.

UK

Westland Wessex



A Wessex HC.Mk 2 of No. 28 Sqn based at Kai Tak, Hong Kong. The squadron's role is mainly one of supporting the Hong Kong police and British Army in anti-illegal immigration operations.

Despite the fact that it is essentially based upon the early 1950s vintage Sikorsky S-58, the **Westland Wessex** is still extensively used by the British armed forces, examples serving with the Royal Air Force and the Fleet Air Arm on a variety of tasks which encompass air-sea rescue, commando assault and logistical support.

Initially acquired to fulfil the Royal Navy's need for a modern and relatively sophisticated anti-submarine warfare helicopter, the Wessex has demonstrated considerable versatility and durability since then. Built under licence and developed by Westland, the Wessex enjoyed the benefits bestowed by turbine power and entered service with the Fleet Air Arm as the **Wessex HAS.Mk 1** during 1960. The next major variant to appear was the **Wessex HC.Mk 2** for the RAF, this being able to carry a payload of 16 troops or seven stretchers when operating in the casevac (casualty evacuation) role.

Further refinement of the specialized ASW equipment brought about the **Wessex HAS.Mk 3** version, which was instantly identifiable by virtue of the distinctive dorsal radome, many of the original Wessex HAS.Mk 1s being retrofitted with this equipment. Two **Wessex HCC.Mk 4** helicopters for The Queen's Flight followed, the final version being the **Wessex HU.Mk 5**. Used solely by the Fleet Air Arm, the Wessex HU.Mk 5 was earmarked principally for assault duties and was the logical replacement for those Westland Whirlwinds which had performed this function for several years. Payload capability of the Wessex HU.Mk 5 was essentially identical to that of the RAF's Wessex HC.Mk 2 and, indeed, both variants are able to carry underslung loads, a valuable option when speed is of paramount concern, as is often the case in combat.

Although less capable than the Sea King HC.Mk 4 with regard to payload, the Wessex HU.Mk 5 was extensively used during the Falklands conflict, taking part in operations on East Falkland and also being involved in lesser actions at South Georgia. Losses were fairly high, largely as a result of the sinking of the *Atlantic Conveyor*, which was carrying a number of Wessex reinforcements when it was struck by an Exocet missile.

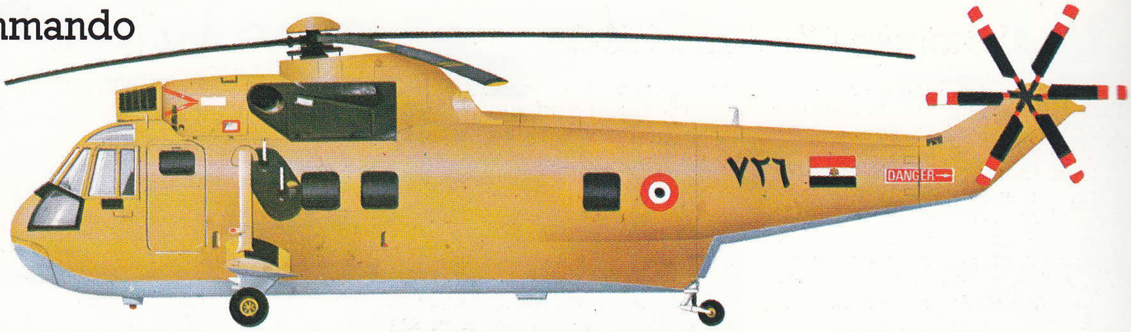
Specification

Westland Wessex HU.Mk 5
Type: tactical transport and assault helicopter
Armament: provision for machine-guns and anti-tank missiles
Powerplant: one Rolls-Royce Coupled Gnome 101/111 limited to total combined power of 1,350 shp (1007 kW)
Performance: maximum speed 212 km/h (132 mph); cruising speed 195 km/h (121 mph); service ceiling 4300 m (14,100 ft); range with standard fuel 628 km (390 miles)
Weights: empty 3927 lb (8,657 lb); maximum take-off 6120 kg (13,500 lb)
Dimensions: main rotor diameter 17.07 m (56 ft 0 in); length of fuselage 14.74 m (48 ft 4½ in); height 4.93 m (16 ft 2 in); main rotor disc area 228.82 m^2 (2,463 sq ft)

A Royal Navy Wessex HU.Mk 5 disembarks a group of Royal Marines on an exercise in Norway. British Wessex helicopters have been used operationally in the Middle East and in the Falklands conflict of 1982. Older Wessex are single-engined.

UK

Westland Commando



The Westland Commando is a dedicated assault version of the naval Sea King helicopter, and has been widely exported. This example is one of 28 operated by the Egyptian air force.

Optimized for tactical military duties, the **Westland Commando** evolved from the Westland Sea King anti-submarine warfare helicopter, itself a development of the original Sikorsky SH-3 Sea King which is widely used by the US Navy.

Lacking specialized ASW equipment, the Commando was originally conceived mainly for the export market and has achieved some success in this field, examples being purchased by Egypt and Qatar. A basically similar machine, known as the **Sea King HC.Mk 4**, has also been acquired by the Royal Navy and this presently serves with two Commando squadrons, being employed purely in the assault role.

Featuring a fixed tail-wheel landing gear and lacking the sponsons of the Sea King, the Commando can carry up to 28 fully-armed troops as well as a crew of two. In addition, it possesses the ability to carry underslung loads of up to 3629 kg (8,000 lb), whilst provision for fitment of armament also exists, the parent company having evaluated a variety of weapons including guns, rocket pods and missiles. A particularly versatile helicopter, the Commando is equally adept at assault, casualty evacuation, logistical support, combat search and rescue and strike tasks.

Unlike the Commando, which is principally intended for use from land bases, the Sea King HC.Mk 4 is frequently deployed aboard aircraft-carriers and thus possesses folding main rotor blades and tail unit to facilitate stowage aboard ship. Airlift capability is slightly less than that of the Commando, at 27 troops or 3402 kg (7,500 lb) of cargo slung externally, but the type more than proved its value in the Falklands during the 1982 campaign, playing a major part in supporting the rapid advance of British troops on Port Stanley. A total of 15 Sea King HC.Mk 4s was obtained, these routinely being used to airlift Royal Marines and possessing the ability to operate in all kinds of environment, ranging from the heat and humidity of the tropics to the bitter cold of the Arctic circle.

Specification

Westland Sea King HC.Mk 4
Type: tactical transport/assault helicopter
Armament: a wide variety of cannon, machine-guns, rockets and missiles can be carried
Powerplant: two Rolls-Royce Gnome H.1400-1 turboshafts each rated at 1,660 shp (1238 kW)
Performance: cruising speed at sea level 208 km/h (129 mph); range with maximum payload and reserves 444 km (276 miles); ferry range with maximum fuel 1460 km (907 miles)
Weights: empty 5,544 kg (12,222 lb); maximum take-off 9525 kg (21,000 lb)
Dimensions: main rotor diameter 18.90 m (62 ft 0 in); length, rotors turning 22.15 m (72 ft 8 in); height 5.13 m (16 ft 10 in); main rotor disc area 280.47 m^2 (3,019 sq ft)

An Egyptian Commando on test in Britain before delivery. The Commando is not used by Britain's armed forces, but the generally similar Sea King HC.Mk 4 was used intensively in the Falklands.

USA

Sikorsky CH-3 and HH-3

A variant of the highly successful **Sikorsky S-61** series which was originally conceived in response to a US Navy requirement, the **CH-3** was intended for service with the US Air Force purely in the transport role, and came about in the early 1960s when the USAF identified a need for a long-range helicopter to resupply the 'Texas Tower' radar facilities situated in the offshore water in the southern USA.

This task was first performed with a trio of **CH-3B** helicopters, these being simply HSS-2s obtained on loan from the USS Navy, and their success soon led to a formal USAF decision to acquire the **CH-3C**. To enable the US Air Force mission to be performed satisfactorily several design changes were recommended, the most obvious of these concerning the aft fuselage which was modified to incorporate a hydraulically-powered rear door and loading ramp, whilst the landing gear was also changed in favour of a more conventional tricycle layout with twin wheels on each unit. In addition, a high degree of self-sufficiency was required for operation at remote sites where ground facilities were lacking, and this necessitated provision of an auxiliary power unit.

Known in company parlance as the **S-61R**, this model made its maiden flight in June 1963, entering service at Tyndall AFB, Florida, just before the end of the same year. A total of 50 helicopters of this type was built for the USAF, production switching in 1966 to the more powerful **CH-3E**, of which 77 were produced although many appeared as (or were later modified to) **HH-3E Jolly Green Giant** standard for service with the Aerospace Rescue and Recovery Service in the combat search and rescue role, in which the type performed many heroic rescue actions in both North and South Vietnam.

Best known for its exploits in the rescue role, the CH-3 is also employed in drone recovery, whilst a handful of examples has seen service with the USAF's small force of special operations squadrons in support of US Army special forces units engaged in clandestine operations. These have now largely given way to the CH-53C.

An essentially similar version, the **HH-3F Pelican**, is widely used by the US Coast Guard on search and rescue duties of a humanitarian nature.

A Sikorsky HH-3E Jolly Green Giant recovers a downed pilot in Vietnam. The HH-3 was used extensively in Vietnam, some in the assault role.

Specification

Sikorsky CH-3E

Type: transport helicopter

Armament: none

Powerplant: two General Electric T58-GE-5 turboshafts each rated at 1,500 shp (1119 kW)

Performance: maximum speed 261 km/h (162 mph); service ceiling 3385 m (11,100 ft); range with maximum fuel and reserves 748 km (465 miles)

Weights: empty 6010 kg (13,255 lb); normal take-off 9635 kg (21,247 lb); maximum take-off 10000 kg (22,050 lb)

Dimensions: main rotor diameter 18.90 m (62 ft 0 in); length, rotors turning 22.25 m (73 ft 0 in); height 5.51 m (18 ft 1 in); main rotor disc area 280.5 m^2 (3,019 sq ft)

USA

Sikorsky CH-53 Sea Stallion

In its present production form as the **CH-53E Sea Stallion**, the Sikorsky S-65 is easily the largest and most powerful helicopter to emerge in the West, prototype examples demonstrating impressive lift capability on numerous occasions in recent years. Design of the basic Sea Stallion in fact dates back to 1960, when the US Marine Corps requested industry to submit proposals for a new type to replace the Sikorsky CH-37 Mojave, a piston-engine type which was then rapidly approaching obsolescence.

Sikorsky responded with the S-65, a quite massive machine with a number of interesting features and with heavy emphasis placed on payload capability and ease of operation in the field. Flown for the first time in prototype form during October 1964, the type was ordered into production with deliveries of the initial variant, the **CH-53A**, beginning in September 1966. Deployment to Vietnam followed swiftly, examples being active from the US Marine Corps facility at Marble Mountain near Da Nang at the beginning of 1967, and thereafter the Sea Stallion played a major part in the remainder of the war, its all-weather capability significantly enhancing heavy-lift resources in that theatre.

The second major production model to see service with the US Marines was the **CH-53D** which was introduced in March 1969 and fitted with more powerful engines a well as a special internal cargo-handling system capable of operation by just one man. Up to 55 fully-armed troops could be carried by the CH-53D, and this derivative still equips several USMC squadrons today.

Other variants which have appeared include the **HH-53B** and **HH-53C**, both for service with the Aerospace Rescue and Recovery Service on combat search and rescue duties, and the **CH-53C** which is employed by the USAF in support of special forces units and to move ground-based tactical radars.

Yet another derivative is the **RH-53D** minesweeper, this using towed sweeping equipment in clearance operations. Currently equipping three US Navy squadrons, the RH-53D was also the model which took part in the disastrous attempt to free the American hostages held in Tehran.

The most recent addition to the Sea Stallion family is the **CH-53E Super Stallion** mentioned above. This is a radically different machine which arose from the realization in the early 1970s that even greater heavy-lift potential would be needed in future by the US Marine Corps. Although its airframe is basically similar to that of earlier models, the CH-53E has three engines driving a seven-bladed main rotor and also incorporates a greatly uprated transmission. The type has recently been introduced to operational service, production is continuing for the US Marines, and the US Navy has plans to obtain the **MH-53E** mine countermeasures model in the fairly near future to replace the RH-53D.

Specification

Sikorsky CH-53E Super Stallion

Type: heavy-lift transport/assault helicopter

Armament: none

Powerplant: three General Electric T64-GE-415 turboshafts each rated at 3,670 shp (2737 kW)

Performance: maximum speed at sea level 315 km/h (196 mph); maximum cruising speed at sea level 278 km/h (173 mph); range at optimum cruise condition with reserves 492 km (306 miles)

Weights: empty 14537 kg (32,048 lb); maximum take-off 31369 kg (69,750 lb)

Dimensions: main rotor diameter 24.08 m (79 ft 0 in); length, rotors turning 22.48 m (73 ft 9 in); height 8.46 m (27 ft 9 in); main rotor disc area 455.36 m^2 (4,901.66 sq ft)

A Sikorsky RH-53D Sea Stallion in the markings of Marine Helicopter Mine Countermeasures Squadron 16. Helicopters from this unit made the ill-fated attempt to rescue America's Embassy hostages in Tehran.

GC
NAVY
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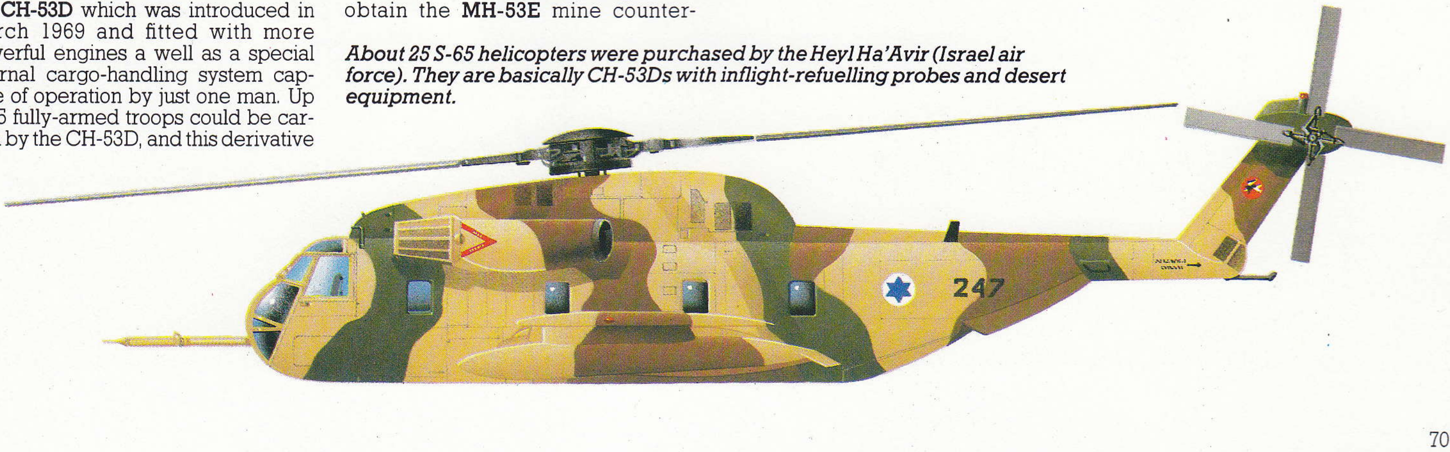
HM-16

About 25 S-65 helicopters were purchased by the Heyl Ha'Avir (Israel air force). They are basically CH-53Ds with inflight-refuelling probes and desert equipment.



Operation 'Eagle Claw'

America's attempt to rescue the hostages held by militant students in Tehran was a bold venture that failed largely due to unserviceability of the RH-53D helicopters, and was made tragic by an accident which destroyed two aircraft and killed eight men.

When militant Iranian students seized the US Embassy and Foreign Affairs buildings in Tehran on 4 November 1979 during the Islamic revolution, they also seized numerous American hostages. Over the next few months the hostages provided much useful propaganda for the new extremist regime and for this reason, as well as concern for the safety of the hostages, the US government made numerous unsuccessful diplomatic attempts to free them. From the early days of the crisis the possibilities of a military solution were also explored, and it has been claimed that an American reconnaissance party was sent into Iran only five days after the embassy had been seized. The reports from this group (as well as the spectacular successes of rescue operations by the Israelis at Entebbe and the West Germans at Mogadishu) may well have prompted the initial decision to free the hostages by armed action despite President Carter's speech to the Congress in early January in which he stated that such an operation 'would almost certainly end in failure and the death of the hostages'.

The obvious choice to conduct a military rescue mission was the US Army's 'Blue Light' or 'Delta' force. This had been established at Fort Bragg, North Carolina, about two years earlier, and its first members had been trained by the SAS in the UK. This force, composed of resourceful and experienced commando troops, was entrusted with the execution of the mission. The process of assembling the various elements which were to take part in Operation 'Eagle Claw' is believed to have begun in late November 1979, when a number of crews were drawn from several US Marine Corps heavy-lift helicopter squadrons. There was some criticisms that these crews were selected more to ensure US Marine Corps participation than for their ability. Six Sikorsky RH-53D Sea Stallion helicopters, drawn from Helicopter Mine Countermeasures Squadron 16, were airlifted to Diego Garcia late in 1979 and were embarked on the aircraft-carrier USS *Kitty Hawk*. The RH-53D was felt to be the helicopter most suitable for the job since, stripped of its minesweeping equipment and provided with additional fuel capacity and navigational equipment, it had sufficient range and payload for the mission. Moreover, as a naval helicopter it looked less out of place on an American carrier; US Air Force or US Army helicopters might have compromised security. The RH-53D also has a folding boom and is thus more easily stored in an aircraft-carrier's hangar deck. These six aircraft were later transferred to USS *Nimitz*, which brought with it two further RH-53Ds.

Mission approval

Intensive training was conducted in the desert around Nellis Air Force Base, Nevada, during March and April 1980. On 14 April President Carter finally approved the mission. One week later the assault squad crossed the Atlantic in Lockheed C-130s, and then flew on to Masirah, an Omani airfield on an island off the coast of Oman. Conflicting reports suggest that Cairo West might have been used as the springboard for the mission but this seems unlikely, although US reconnaissance aircraft had been making intensive use of airfields in Egypt in connection with the Iran crisis, and the C-130s probably did refuel at Cairo West before flying on to Masirah.

Intensive US Navy manoeuvres were already under way in the Indian Ocean and these, involving two carrier task groups, served to camouflage preparations for the rescue mission. Their presence may also indicate serious consideration of alternative military solutions to the crisis, such as a naval blockade or a punitive strike on Iranian wells and refineries.

The assault team consisted of 93 men from 'Delta Force' to rescue the bulk of the hostages from the Embassy, and another 13 from 'another unit' to rescue the three hostages from the Foreign Affairs building. On 24 April this team was airlifted from Masirah to Desert One, a small airstrip 480 km (300 miles) south east of Tehran, in Lockheed MC-130E Hercules from the 7th Special Operations Squadron based at Ramstein in Germany. The MC-130E is a version of the Hercules designed specifically for clandestine infiltration missions at low level and is equipped with comprehensive ECM and electronic warfare equipment. Three EC-130E Hercules from the 7th Airborne Command and Control Squadron accompanied the MC-130s, carrying fuel cells with which to refuel RH-53Ds, which were to rendezvous with the assault force at Desert One.

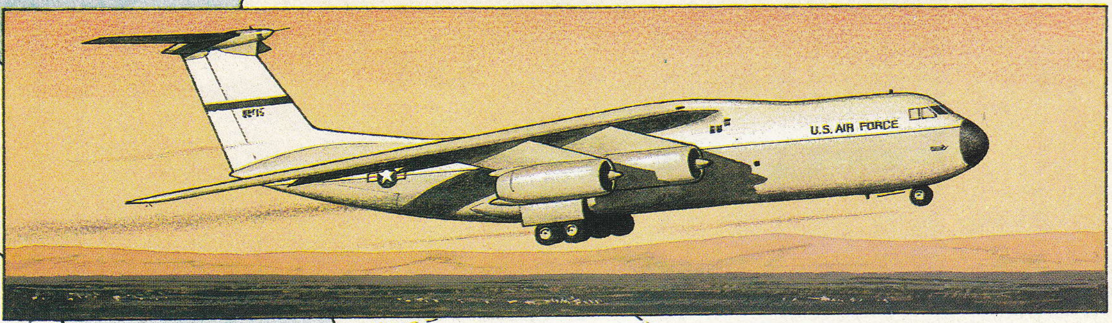
The six Hercules arrived at Desert One on schedule with little difficulty. A team had already visited the airstrip and installed a radio beacon in late March, and it is believed that USAF C-130s had used the airstrip some two years earlier on earthquake relief operations.

The C-130s were to have been joined some 30 minutes later by the eight RH-53Ds, which were to be refuelled before transporting the assault force to Desert Two, another desert strip 105 km (65 miles) south east of Tehran

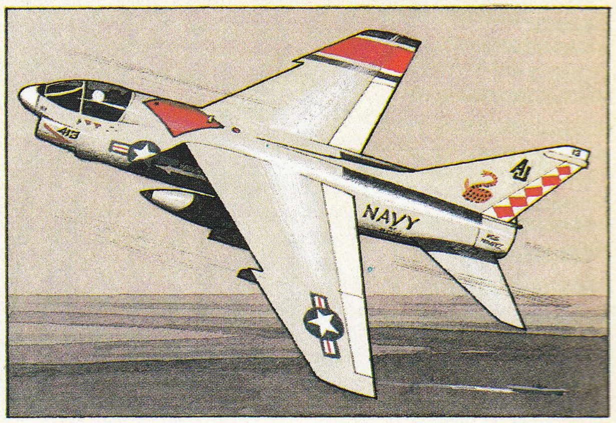
As the evening draws in and light begins to fade, final preparations are made to the eight Sikorsky RH-53Ds on the deck of USS Nimitz *while their crews wait, tense and nervous.*

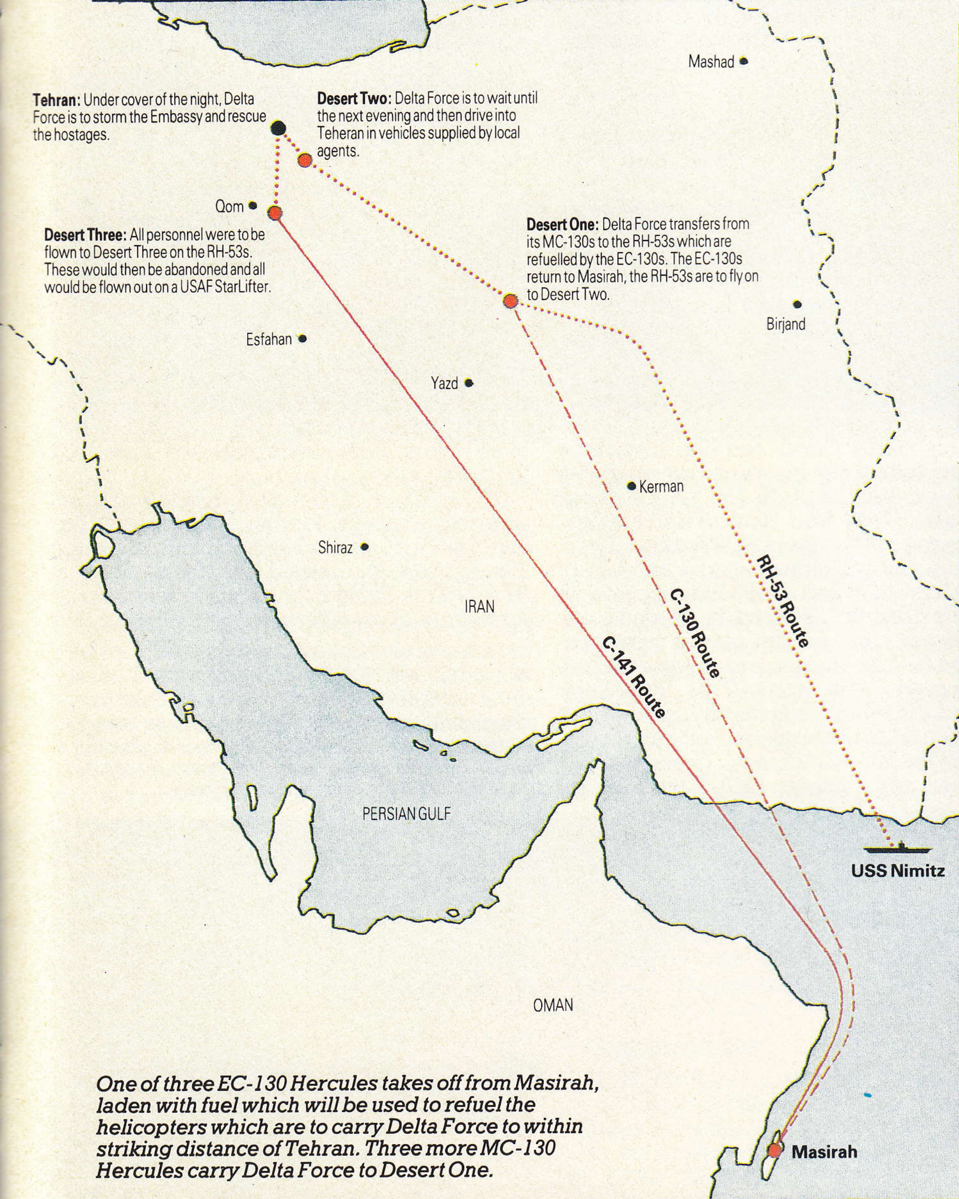
Eagle Claw- The Plan

USAF C-141 StarLifter lands at Desert Three, an Iranian airfield which was to have been secured by a force of Rangers and held until hostages and rescuers had been evacuated.



F-14 Tomcats and A-7 Corsairs from USS Nimitz and USS Coral Sea are tasked with providing fighter cover and air support should it be required. Carrier based aircraft are to escort the RH-53s from Tehran to Desert Three after Delta Force have freed the hostages.



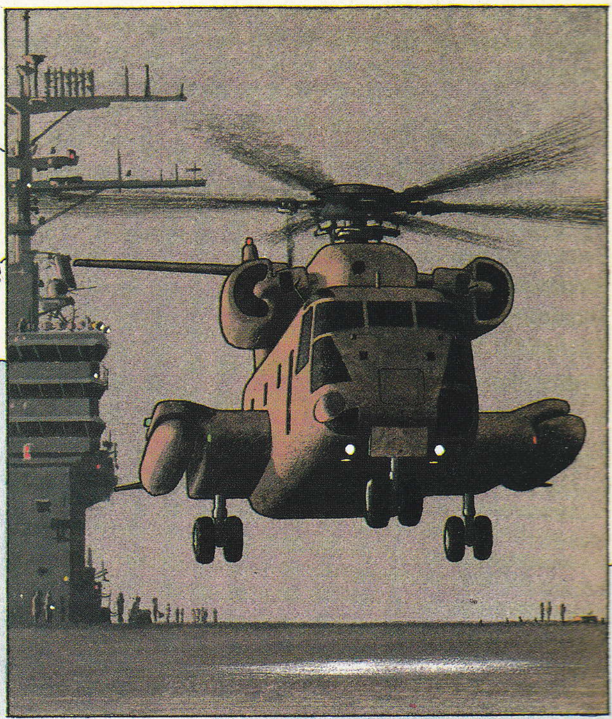


Tehran: Under cover of the night, Delta Force is to storm the Embassy and rescue the hostages.

Desert Two: Delta Force is to wait until the next evening and then drive into Teheran in vehicles supplied by local agents.

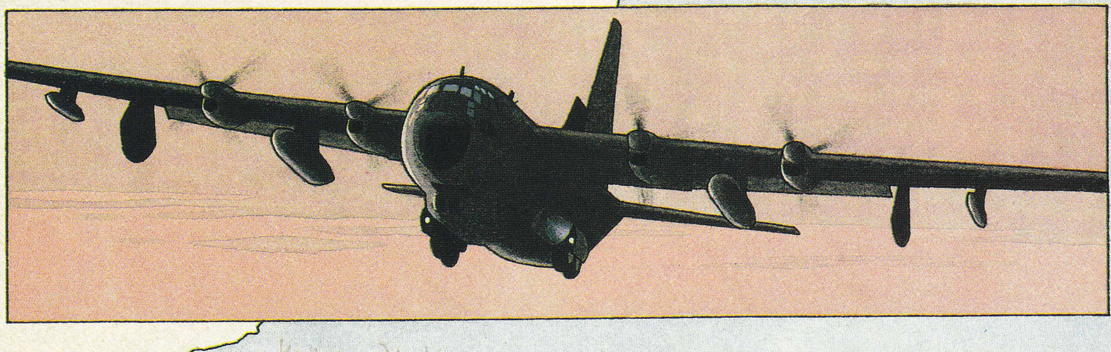
Desert Three: All personnel were to be flown to Desert Three on the RH-53s. These would then be abandoned and all would be flown out on a USAF StarLifter.

Desert One: Delta Force transfers from its MC-130s to the RH-53s which are refuelled by the EC-130s. The EC-130s return to Masirah, the RH-53s are to fly on to Desert Two.

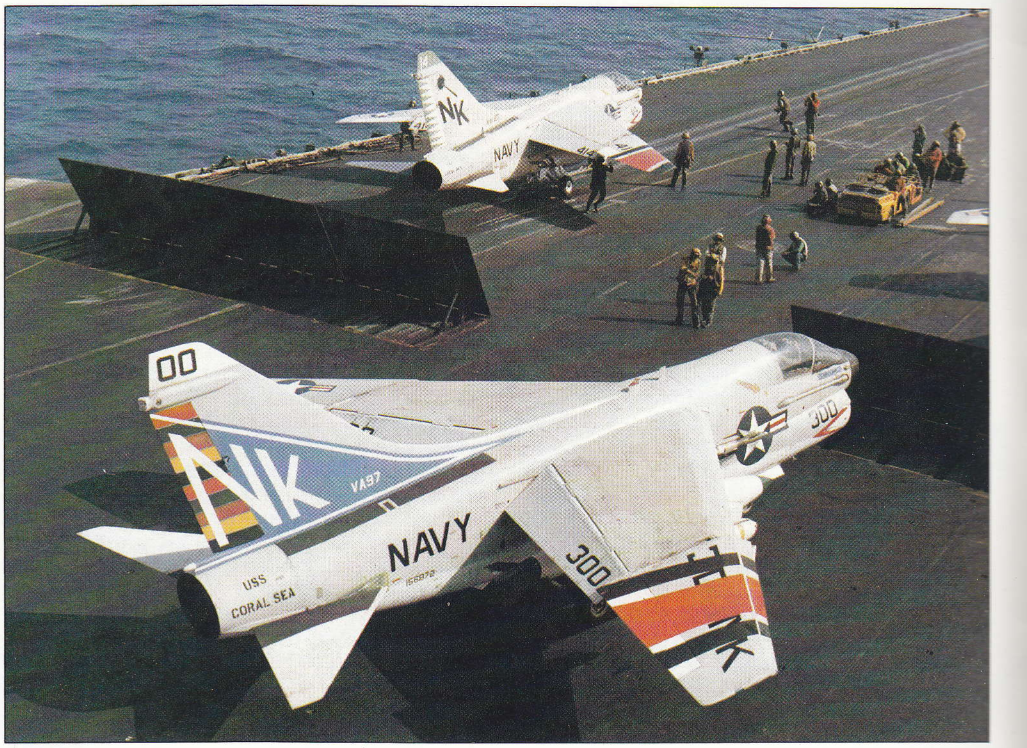


The last of eight RH-53 Sea Stallions lifts off from USS Nimitz to begin its long journey to Desert One. Here the RH-53s will refuel and pick up the Commandos who are to make the rescue bid. They are to be flown to Desert Two, where they will wait until the following evening before driving into Tehran.

One of three EC-130 Hercules takes off from Masirah, laden with fuel which will be used to refuel the helicopters which are to carry Delta Force to within striking distance of Tehran. Three more MC-130 Hercules carry Delta Force to Desert One.



An A-7 Corsair of VA-97 'War Hawks' waits to be launched. Another Corsair, of VA-27 'Royal Maces', is in position on USS* Coral Sea*'s port catapult. Both aircraft bear the distinctive recognition stripes applied to aircraft participating in Operation 'Eagle Claw'.

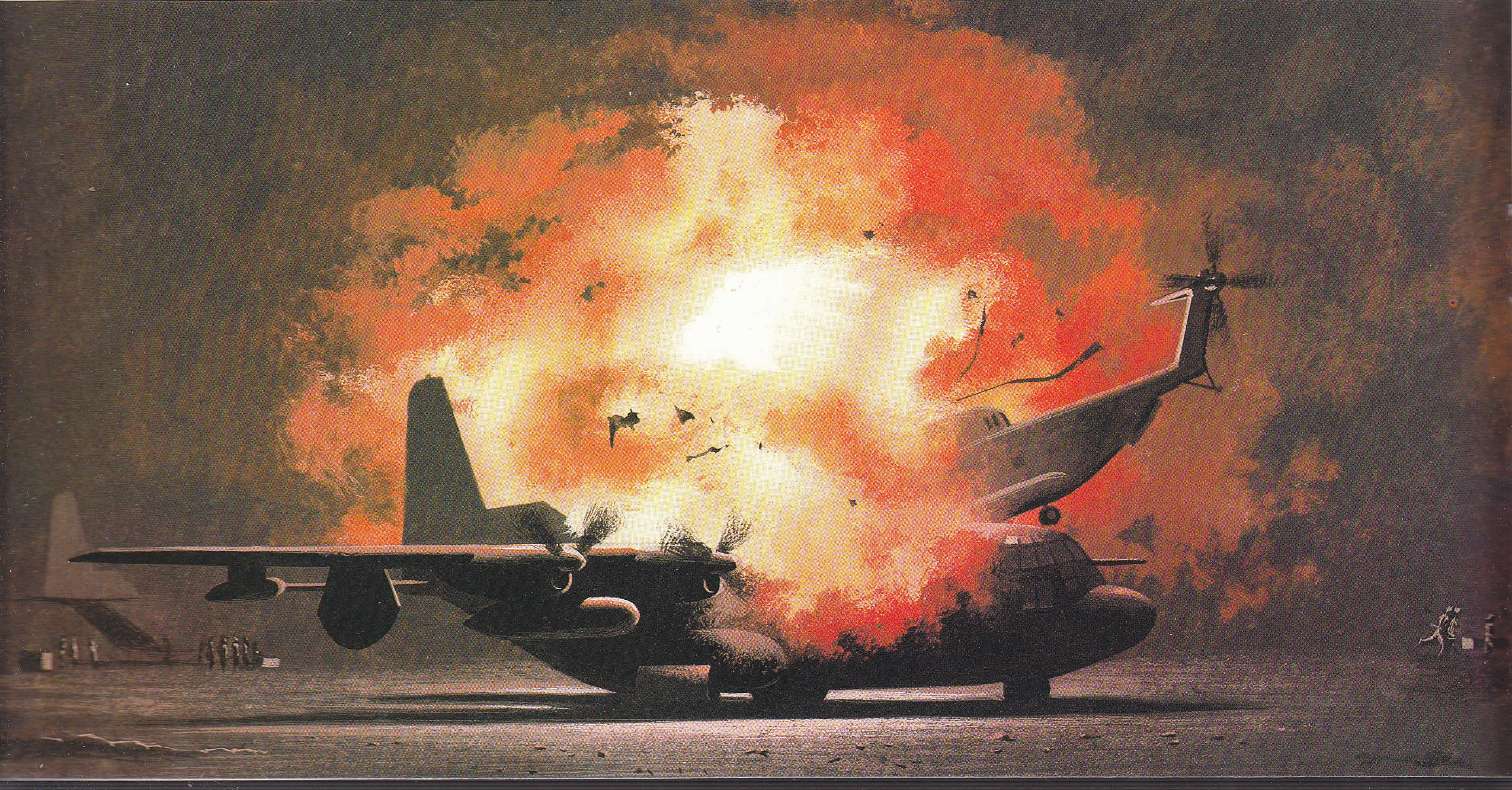


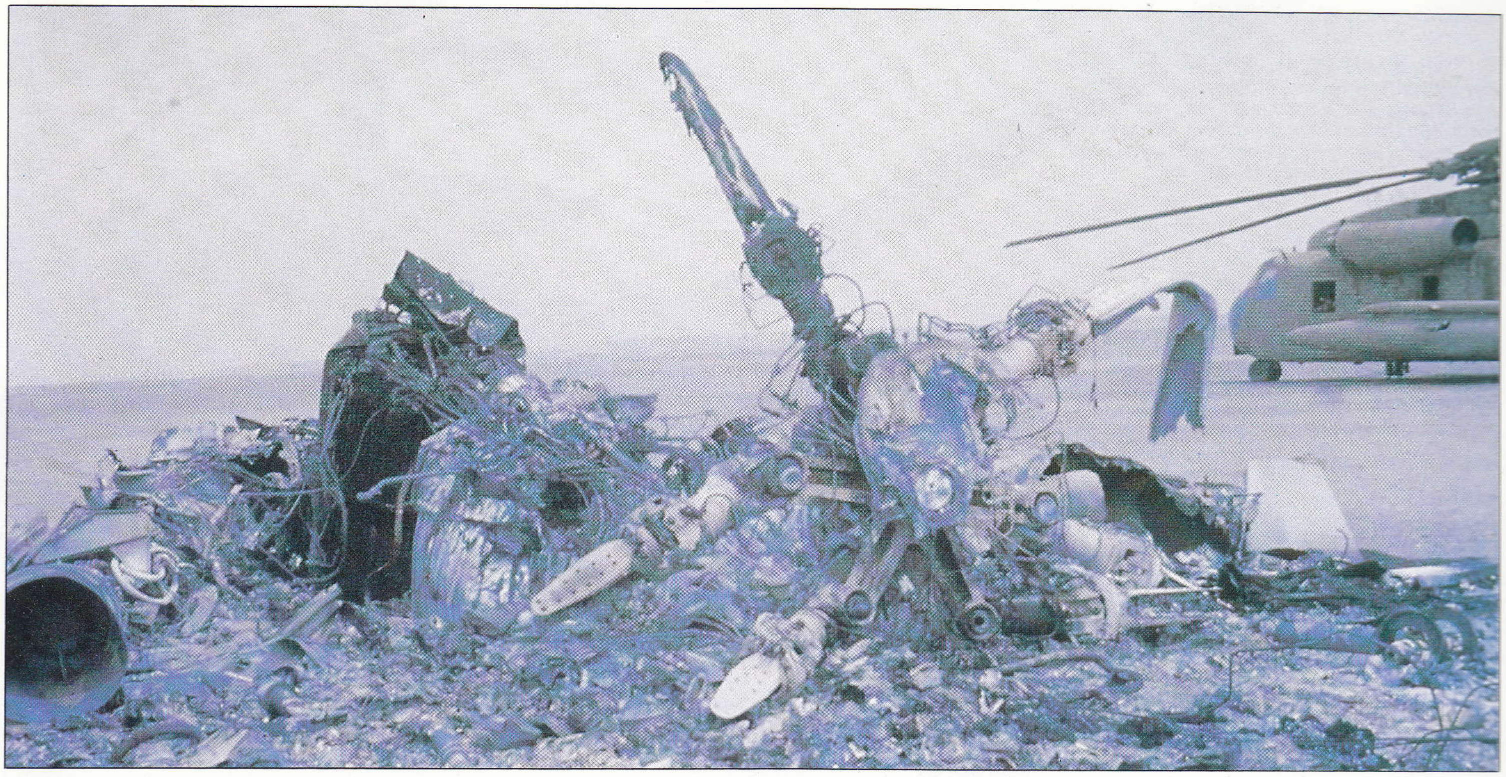
near the town of Garmsar, landing one hour before sunrise. The assault force was to be met at Desert Two by Iranian agents with various vehicles and, after nightfall, driven to Tehran. There Iranian agents, co-ordinated by an American agent travelling on false papers, were already to have infiltrated the Embassy compound before the men of the 'Delta Force' stormed the Embassy, using a non-fatal paralysing nerve gas to immobilize the guards. When the Embassy had been secured the RH-53Ds were to fly in and land in the compound, or if this were impossible the nearby football stadium, to airlift out the assault force, agents and hostages. Meanwhile a Hercules gunship was to be circling the Mehrabad international airport to prevent Iranian fighter aircraft from being scrambled, with another circling over the Embassy, tasked to prevent Iranian armour moving up during the raid and then to destroy the Embassy after the evacuation. The assault force and hostages were to be flown to Desert Three, the Iranian airfield of Manzariyeh, which was to have been secured earlier by a contingent of American Rangers. The RH-53Ds were to be abandoned and destroyed, and everyone flown out on board USAF Lockheed C-141 StarLifters. It is thought likely that Iranian radar and communications were to have been jammed by Grumman EA-6B Prowlers from the *Nimitz*, and fighter cover to have been provided, if necessary, by Grumman F-14 Tomcats from the same ship. It is possible that air strikes would have been launched to prevent Iranian air force interference, but this seems unlikely as great care had been taken to avoid Iranian casualties and any ensuing major international incident.

Strike aircraft from both the USS *Nimitz* and USS *Coral Sea* were certainly committed to Operation 'Eagle Claw', carrying distinctive recognition stripes on the starboard wing. The *Coral Sea*'s Vought A-7s (of VA-27 'Royal Maces' and VA-97 'War Hawks') and McDonnell Douglas F-4Ns (from VMFA-323) all carried black and red stripes, as did the A-7s of VA-82 'Marauders' and VA-86 'Sidewinders' on the *Nimitz*. Some VA-35 'Black Panthers' Grumman A-6 Intruders carried similar markings, and there is some evidence to suggest that the *Nimitz*-based F-14s, from VF-41 'The Black Aces' and VF-84 'The Jolly Rogers', carried red and black bands, and it seems likely that Prowlers, Lockheed S-3 Vikings, Grumman E-2 Hawkeyes and Douglas EKA-3 Skywarriors would have carried such markings if involved in the operation.

The journey of the eight RH-53Ds did not progress smoothly, for only six arrived at Desert One and all were substantially delayed. The helicopters crossed the Iranian coast at 30 m (100 ft), flying in pairs in a loose diamond formation. Soon afterwards one helicopter

***The moment of tragedy. With the mission already aborted, one of the RH-53s collides with a fuel-laden Hercules as it positions for a top-up of fuel for the long journey back to USS* Nimitz.**





Aftermath. The wreckage of the crashed RH-53 lies in front of one of the abandoned aircraft. The Americans left behind the two crashed aircraft, eight dead and the five surviving helicopters.

made an emergency landing suspecting an imminent rotor blade failure. The helicopter was abandoned and its crew picked up by another RH-53D, which continued to the rendezvous although now some way behind schedule.

Meanwhile the rest of the formation had been encountering problems of its own as it ran into an unforeseen dust cloud. The flights lost visual contact with one another, one flight landing and spending 20 minutes on the ground while the other aircraft pressed on through the dust cloud. One aircraft was forced to turn back and return to the *Nimitz* after losing part of its flight control system and many instruments. The remaining helicopters struggled into Desert One individually, all arriving between 50 and 85 minutes late. The remaining Hercules (at least one of the MC-130s having flown out immediately) had been at Desert One for some two hours and had kept their engines running for all this time to eliminate the need for ground power units to restart. The tension of waiting for the helicopters at Desert One had been relieved on a couple of occasions. The first incident occurred soon after arrival when a busload of Iranians was sighted on the road running past Desert One; the bus was stopped and the passengers detained. Soon afterwards a truck arrived, and this stopped only when American troops opened fire, the driver escaping in another car.

One helicopter unserviceable

The helicopters were refuelled from huge rubber balls full of fuel, towed from helicopter to helicopter by a jeep which had been brought in by one of the MC-130s. One helicopter was found to have a serious and potentially hazardous fault in its hydraulic system. Two conflicting reports state that this was caused by a heavy landing at Desert One or that it developed on the journey. By 02.15 it was apparent that this helicopter could neither be repaired nor used without risking the loss of its hydraulic system: in the latter event the flight controls would lock and the helicopter would crash.

The position was reported to the Boeing E-3A communications aircraft circling at 9145 m (30,000 ft) over the Persian Gulf. The news was passed via the USS *Nimitz* and the Pentagon to President Carter. Some reports indicate that the commanders on the spot pleaded to be allowed to continue with the mission despite the fact that only five RH-53Ds remained and six had been assessed as the minimum number necessary. Intelligence sources in Paris say that the Israelis monitored the transmissions between the *Nimitz* and the Pentagon and that these exchanges were 'heated and acrimonious'. The White House reported that the decision to abort the mission was unanimous. Whichever version is true, it is indisputable that President Carter did order the mission to be aborted and instructed the *Nimitz* to 'take any military action necessary to extricate our forces'.

Tragedy strikes

If the decision to abort the mission was a bitter pill, what followed was the stuff of which tragedy is made. The five remaining serviceable helicopters were dispersed around the EC-130Es. The first to arrive and refuel needed a top-up of fuel before its return to the *Nimitz*, and to permit this another helicopter had to move clear. This lifted off amidst a large dust cloud, banking slightly as it passed over the wing of the EC-130. A main rotor blade sliced into the fuselage of the EC-130, causing a major explosion and fire which engulfed both aircraft and helicopter. Detonating ammunition hampered evacuation of personnel from both machines and also damaged some of the remaining RH-53Ds. The accident claimed the lives of the five flightdeck crew in the EC-130 and three of those in the helicopter.

Subsequently all remaining personnel were evacuated from Desert One aboard the surviving EC-130s and MC-130s, which were themselves getting critically low on fuel. The remaining RH-53Ds were abandoned, and there was insufficient time to sabotage them or to recover the eight bodies before the C-130s flew back to Ramstein via Masirah and probably Bahrain. It seems likely that a refuelling stop was made at Bahrain, the Greeks having revealed that they gave overflight permission to three USAF aircraft en route from Bahrain to Ramstein, carrying US servicemen with serious burns.

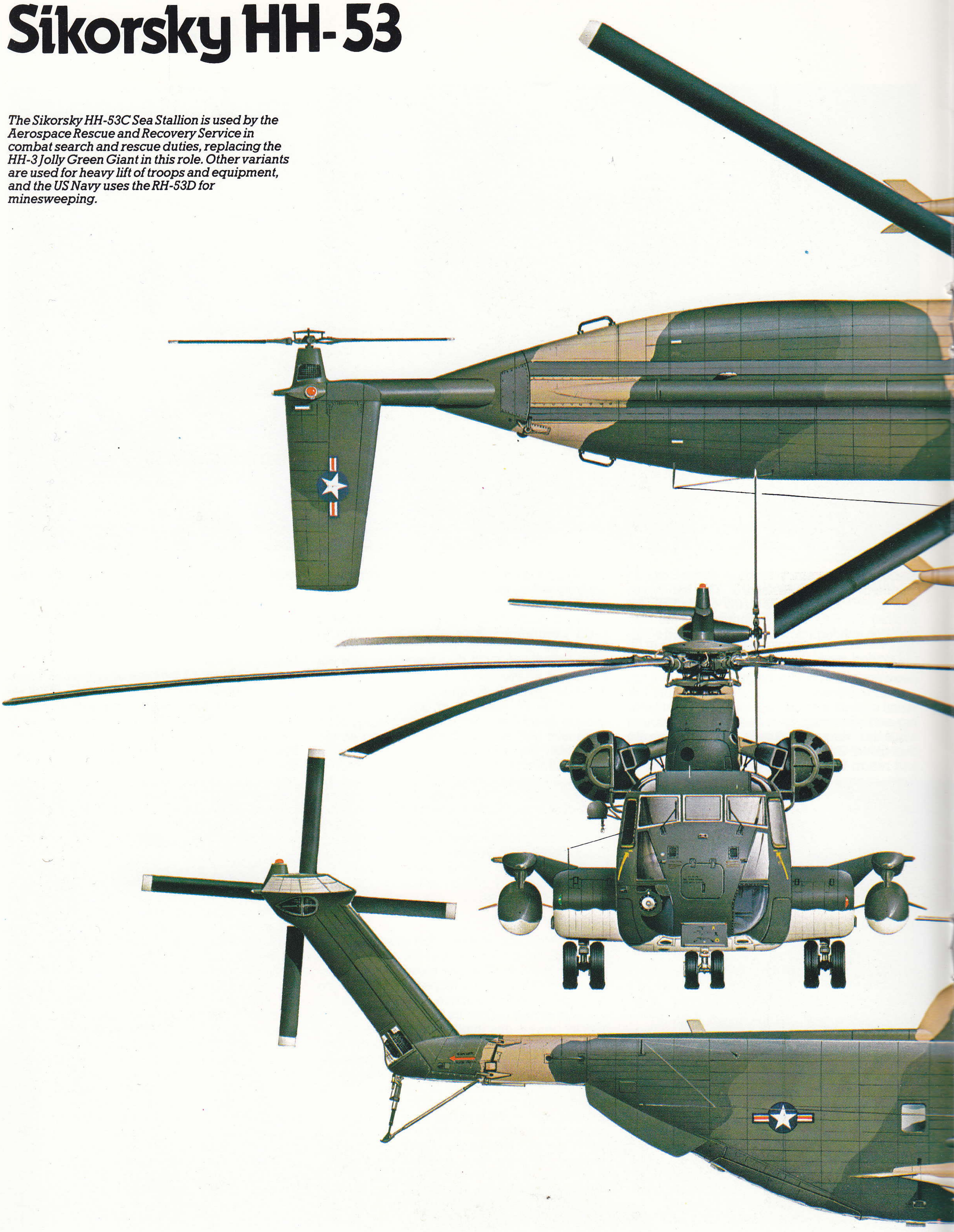
A bold venture

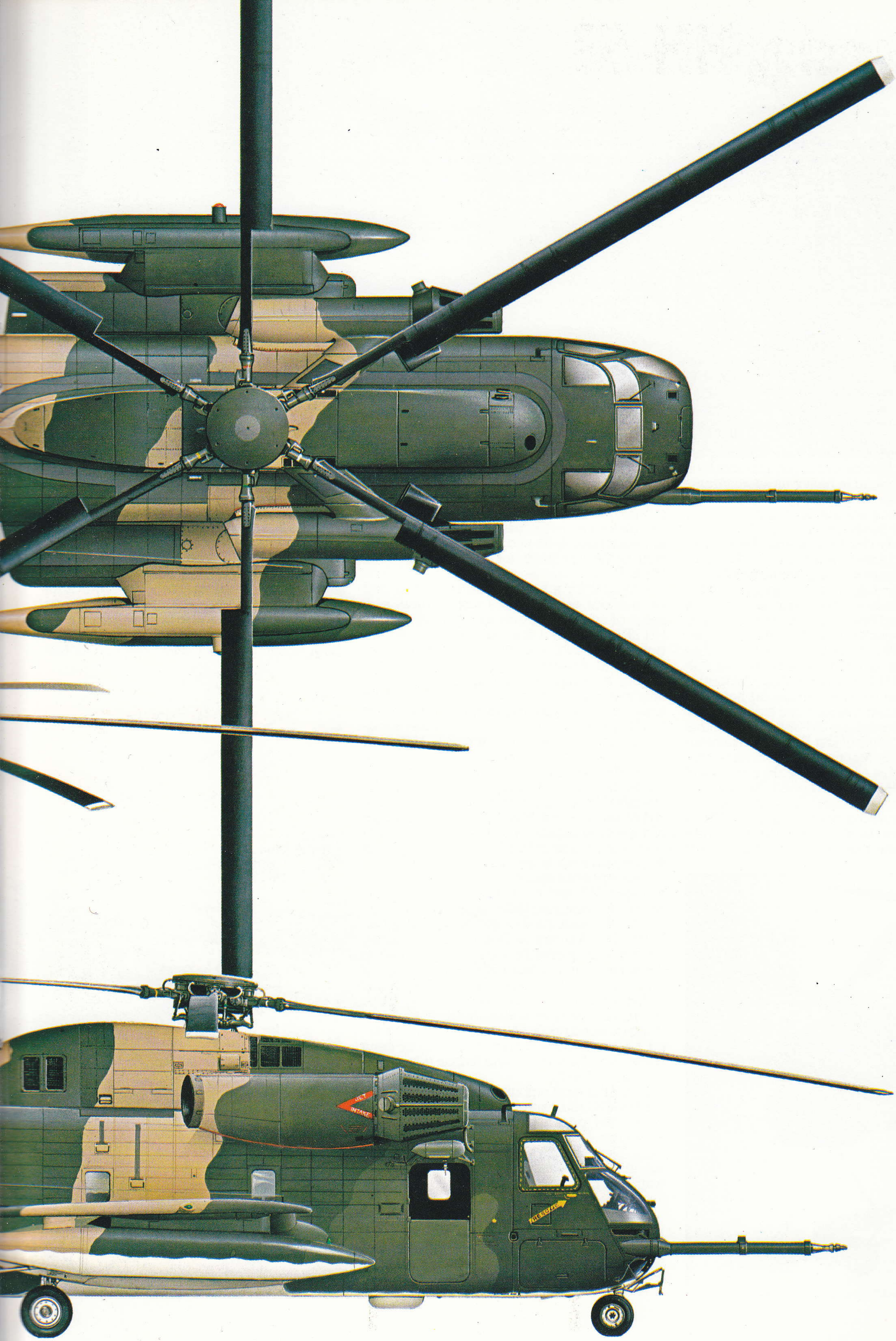
The operation might have worked, but it would have required meticulous timing, unwary guards and a large slice of luck which did not, in the event, materialize. It had been well rehearsed with apparently generous margins for error, and it was unexpectedly bold. Its unexpectedness can be gauged by the fact that the Iranian defence ministry knew nothing of the attempt until one hour after the White House announcement when the Tehran correspondent of a British radio station telephoned for comments. The serviceability of the RH-53s seems to have been atrocious, but eight was the maximum number which could be fitted into the hangar deck of the *Nimitz*, and had aircraft been stored on deck serviceability might well have been even lower.

Operation 'Eagle Claw' was indisputably a bold plan of considerable scale, but was probably doomed to failure by the very facts that it was over-ambitious and that insufficient planning had been made for contingencies such as bad weather, unserviceabilities and Iranian intervention, all of which occurred.

Sikorsky HH-53

The Sikorsky HH-53C Sea Stallion is used by the Aerospace Rescue and Recovery Service in combat search and rescue duties, replacing the HH-3 Jolly Green Giant in this role. Other variants are used for heavy lift of troops and equipment, and the US Navy uses the RH-53D for minesweeping.




JET INTAKE
RESCUE

Sikorsky H-53 in Action

Perhaps the world's most versatile heavy helicopter, the H-53 Sea Stallion was designed to meet a US Marine Corps requirement for a heavy assault helicopter. The aircraft has been subjected to rigorous development and has been pressed into service in a large number of roles; the latest variant, the CH-53E, has three engines and a seven-bladed rotor, and is perhaps the most capable military helicopter ever built.

Undoubtedly one of the most impressive heavy-lift helicopters flying anywhere in the world today, the Sikorsky H-53 Sea Stallion has, despite its large size, proved to be a most versatile machine and at present serves with three of the four major elements of the US armed forces. In addition, it has also achieved some success in the export market, overseas customers including West Germany, Israel, Iran and Austria, and despite the fact that the basic design dates back to the early 1960s it has demonstrated considerable growth potential, remaining in production in its three-engine H-53E form for both the US Navy and US Marine Corps at the time of writing.

The H-53 was originally conceived in response to a US Marine Corps requirement for a new and more capable heavy-lift assault/transport helicopter to replace the somewhat grotesque piston-engine Sikorksy H-37 Mojave, and early development of the CH-53 was rewarded in July 1962 by a contract for a pair of prototypes and a static test airframe. Construction of these began almost immediately, the first prototype making a successful maiden flight on 14 October 1964. Flight testing of the design revealed few problems and deliveries of production-configured CH-53As got under way less than two years later, on 9 September 1966, the first squadron to receive the Sea Stallion being HMH-463 at Santa Ana, California.

Such was the need for enhanced heavy-lift capability in South Vietnam that little time was wasted in deploying the CH-53A to the combat zone, an initial batch of four HMH-463 machines reaching Marble Mountain near Da Nang on 8 January 1967. Just over two weeks later one of these successfully accomplished the first helicopter retrieval operation to be undertaken by this type in Vietnam, a disabled Sikorsky UH-34 being recovered from the landing platform of a US Navy hospital ship. In fact, the deployment of this quartet of CH-53As was basically intended to permit assessment of the type in combat conditions and it was not until late May that the rest of the squadron reached Vietnam, bringing with it a further 22 Sea Stallions. By this time, the original four machines had successfully recovered no less than 101 US Marine Corps helicopters as well as a brace of USAF aircraft, and the advent of additional CH-53s significantly enhanced airlift capability, evidence of this being furnished by the fact that in mid-1967 this type was carrying about 75 per cent of Marine Aircraft Group 16's total tonnage and passengers while simultaneously being responsible for only about 16 per cent of the flying hours accumulated by this organization.

At about the same time as deliveries to the US Marine Corps began, the US Air Force selected the Sea Stallion for use by its Aerospace Rescue and Recovery Service, placing an order for an initial quantity of eight HH-53Bs in September 1966 and quickly following up with further contracts for the more powerful HH-53C.

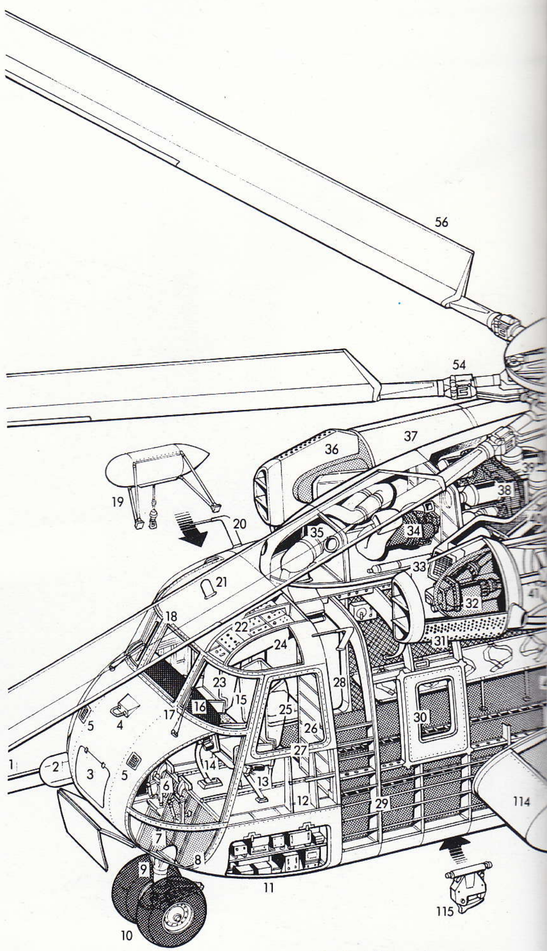
The hunt for a new rescue helicopter had been under way for some time, largely as a result of combat experience with the smaller HH-3E. Although a fine helicopter in its own right, the HH-3E was somewhat limited with regard to combat duty, lacking sufficient armour to ensure survival whilst it possessed only marginal hover capability in hot and high situations of the type frequently encountered in South East Asia. Additionally, defensive armament was restricted to just a pair of M60 7.62-mm (0.3-in) machine-guns, insufficient firepower to counter enemy ground forces in what might best be described as 'hairy' rescue attempts. Accordingly, the USAF opted for the HH-53 which offered the only realistic prospect of improving capability at short notice, initially borrowing a pair of USMC CH-53As to permit aircrew training to get under way.

Delivery of the service's own HH-53Bs began in June 1967 and once again little time was wasted in deploying these to the combat zone, the first two examples joining Detachment Two of the 37th Aerospace Rescue and Recovery Squadron at Udorn, Thailand, in September of the same year. Six more HH-53Bs followed in due course. Deployment of the HH-53C began in September 1969, and the advent of these machines greatly increased the chances of rescuing downed pilots whilst they also later played a part in the evacuations of Phnom Penh (Operation 'Eagle Pull') and Saigon (Operation 'Frequent Wind').

By far the most ambitious rescue attempt by the HH-53C must surely have been that made to Son Tay prison, just 45 km (28 miles) from Hanoi, on the night of 20/21 November 1970. Code-named 'Ivory Coast' and intended to result in the recovery of almost 100 prisoners of war, this bold and imaginative operation involved no less than 116 aircraft and helicopters. In the event, all this effort proved fruitless, for Son Tay camp had in fact been cleared of prisoners by the preceding July, although it still housed numerous soldiers and other personnel so that aerial reconnaissance had confirmed that the facility was still occupied by POWs. Despite being unable to accomplish its objective, the mission was highly successful from the tactical standpoint and certainly resulted in boosting morale of the many American POWs who realized that their plight was not being forgotten.

In addition to the HH-53C rescue derivative, the US Air Force also acquired 20 examples of the CH-53C model for tactical duties. Initially assigned to the 56th Special Operations Wing at Nakhon Phanom, Thailand, these lacked specialized rescue equipment and inflight refuelling gear. They also played a major part in the evacuations of Saigon and Phnom Penh, as well as in the disastrous attempt to recover the crew of the SS *Mayaguez* in May 1975, when 230 US Marines were landed on Koh Tang island in the South China Sea. Six HH-53Cs and five CH-53Cs took part in the whole operation, although only eight were initially involved in the assault, which had been expected to meet only slight opposition. In point of fact, however, sizable and well-armed enemy forces lay in wait and these directed heavy and accurate small arms, rocket and mortar fire towards the helicopters as they began to offload troops, destroying one, knocking out another and severely damaging a third which eventully had to ditch about 1.6 km (1 mile) offshore. Subse-

A CH-53A Sea Stallion lifts a 5761-kg (12,700-lb) 155-mm howitzer during operations in Vietnam. Sea Stallions saw extensive service there in the combat search and rescue, assault and heavy lift roles.



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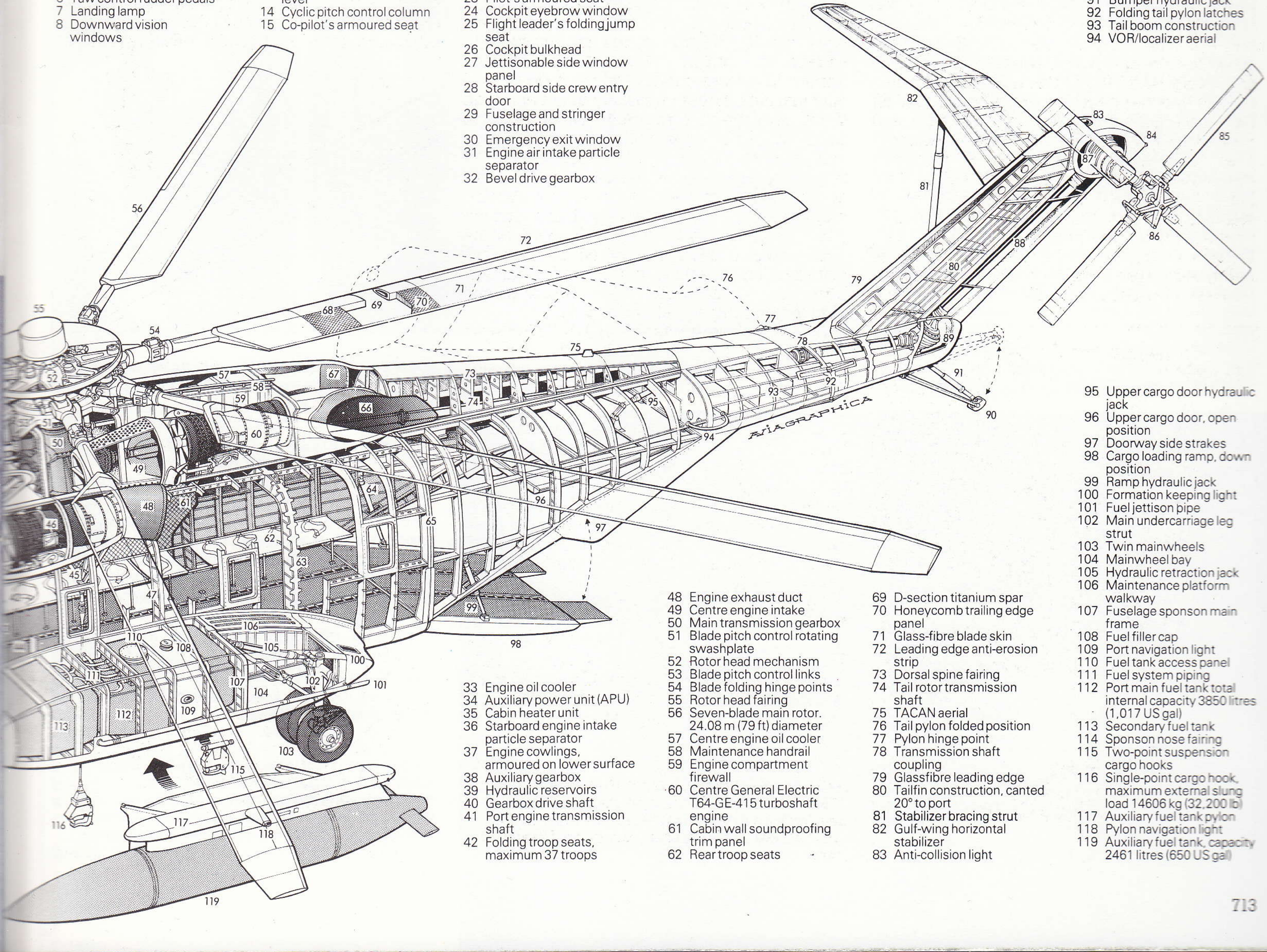
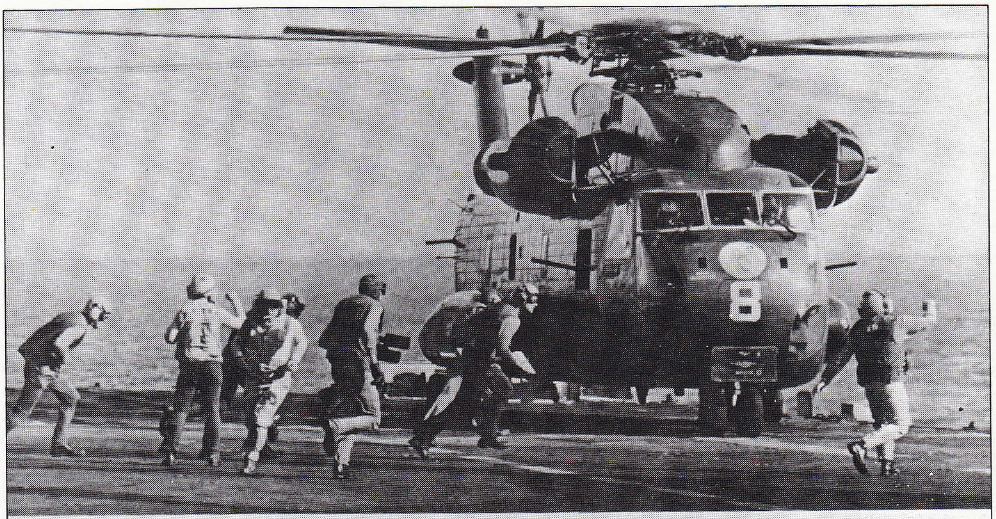
Rotor blade tip vortices nearly form a ring as a USAF HH-53C hovers over the Vietnamese jungle. The HH-53 played a major role in Vietnam, being equipped with armour, armament and an inflight-refuelling probe, as well as comprehensive assault gear.

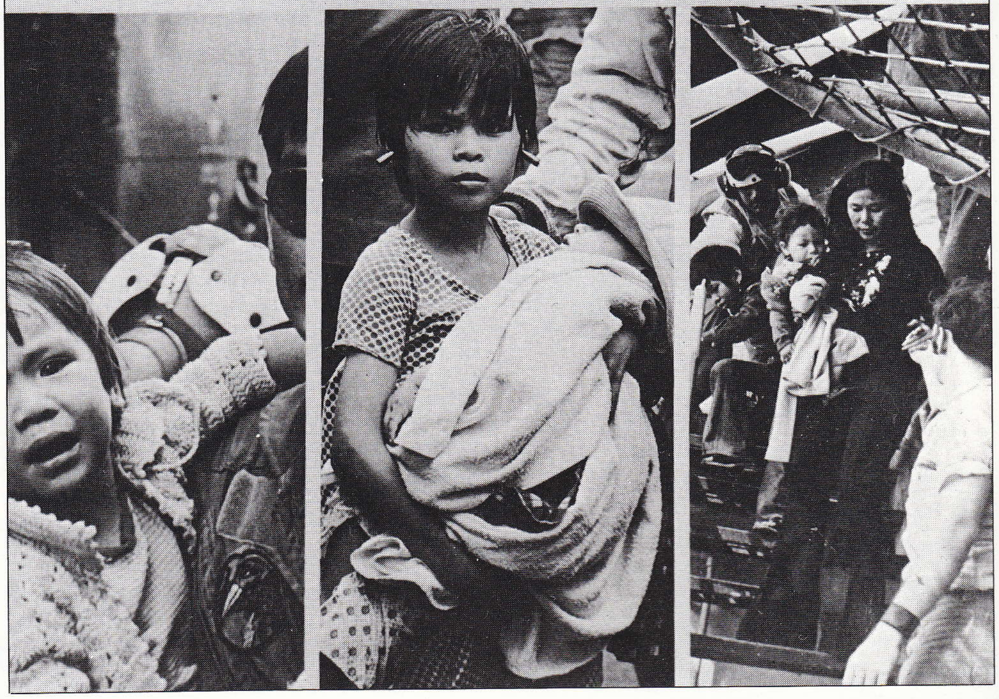
Sikorsky CH-53E Super Stallion cutaway drawing key

1 Retractable inflight refuelling boom
2 Refuelling boom fairing
3 Instrument compartment access door
4 Glideslope aerial
5 Fresh air intakes
6 Yaw control rudder pedals
7 Landing lamp
8 Downward vision windows
9 Nose undercarriage leg strut
10 Twin nosewheels
11 Radio and electronics bay, port and starboard
12 Cockpit floor level
13 Collective pitch control lever
14 Cyclic pitch control column
15 Co-pilot's armoured seat
16 Instrument panel shroud
17 Windscreen wipers
18 Windscreen panels
19 Rescue hoist/winch
20 Pitot tube
21 UHG aerial
22 Overhead control panel
23 Pilot's armoured seat
24 Cockpit eyebrow window
25 Flight leader's folding jump seat
26 Cockpit bulkhead
27 Jettisonable side window panel
28 Starboard side crew entry door
29 Fuselage and stringer construction
30 Emergency exit window
31 Engine air intake particle separator
32 Bevel drive gearbox
33 Engine oil cooler
34 Auxiliary power unit (APU)
35 Cabin heater unit
36 Starboard engine intake particle separator
37 Engine cowlings, armoured on lower surface
38 Auxiliary gearbox
39 Hydraulic reservoirs
40 Gearbox drive shaft
41 Port engine transmission shaft
42 Folding troop seats, maximum 37 troops
43 Cargo loading floor
44 Roller conveyor
45 Cargo hook support links
46 General Electric T64-GE-415 turboshaft engine
47 Gearbox mounting fuselage main frame
48 Engine exhaust duct
49 Centre engine intake
50 Main transmission gearbox
51 Blade pitch control rotating swashplate
52 Rotor head mechanism
53 Blade pitch control links
54 Blade folding hinge points
55 Rotor head fairing
56 Seven-blade main rotor. 24.08 m (79 ft) diameter
57 Centre engine oil cooler
58 Maintenance handrail
59 Engine compartment firewall
60 Centre General Electric T64-GE-415 turboshaft engine
61 Cabin wall soundproofing trim panel
62 Rear troop seats
63 Fuselage/main undercarriage main frame
64 Cargo ramp hydraulic jack
65 Production break double frame
66 Centre engine exhaust duct
67 Oil cooler exhaust
68 Rotor blade cross-section
69 D-section titanium spar
70 Honeycomb trailing edge panel
71 Glass-fibre blade skin
72 Leading edge anti-erosion strip
73 Dorsal spine fairing
74 Tail rotor transmission shaft
75 TACAN aerial
76 Tail pylon folded position
77 Pylon hinge point
78 Transmission shaft coupling
79 Glassfibre leading edge
80 Tailfin construction, canted 20° to port
81 Stabilizer bracing strut
82 Gulf-wing horizontal stabilizer
83 Anti-collision light
84 Tail navigation light
85 Four-blade tail rotor, 6.1 m (20 ft) diameter
86 Tail rotor pitch control mechanism
87 Tail rotor gearbox
88 Final rotor gearbox
89 Bevel gearbox
90 Retractable tail bumper
91 Bumper hydraulic jack
92 Folding tail pylon latches
93 Tail boom construction
94 VOR/localizer aerial
95 Upper cargo door hydraulic jack
96 Upper cargo door, open position
97 Doorway side strakes
98 Cargo loading ramp, down position
99 Ramp hydraulic jack
100 Formation keeping light
101 Fuel jettison pipe
102 Main undercarriage leg strut
103 Twin mainwheels
104 Mainwheel bay
105 Hydraulic retraction jack
106 Maintenance platform walkway
107 Fuselage sponson main frame
108 Fuel filler cap
109 Port navigation light
110 Fuel tank access panel
111 Fuel system piping
112 Port main fuel tank total internal capacity 3850 litres (1,017 US gal)
113 Secondary fuel tank
114 Sponson nose fairing
115 Two-point suspension cargo hooks
116 Single-point cargo hook, maximum external slung load 14606 kg (32,200 lb)
117 Auxiliary fuel tank pylon
118 Pylon navigation light
119 Auxiliary fuel tank, capacity 2461 litres (650 US gal)



The capacious RH-53 played a major role in Operation 'Frequent Wind', America's final humiliating withdrawal from Vietnam. Helicopters like this one saved both Americans and South Vietnamese, all of whom were desperate to escape before the Communists arrived.





quently, the next 14 hours witnessed desperate attempts to extract the luckless US Marines, an objective which was eventually achieved without further loss of helicopters although most of those which took part sustained damage.

Ironically, just three hours after the first US Marines landed, the crew of the *Mayaguez* was discovered aboard a Thai fishing boat intercepted by a US Navy destroyer.

The next major variant to appear was the CH-53D for the US Marine Corps, and this differed from the earlier CH-53A in being fitted with more powerful engines as well as an internal cargo handling system operable by just one man. Capable of airlifting up to 55 fully equipped troops, the CH-53D began to enter service during March 1969 and remained in production until early in 1972, being followed by 30 examples of the specialist RH-53D for mine countermeasures duties, and it was this latter variant which formed the principal element of the ill-fated attempt to rescue the American hostages from the US Embassy in Tehran during April 1980.

Delivery of the RH-53D to US Navy Squadron HM-12 got under way in late 1973, helicopters of this type subsequently taking part in mine clearance operations in Haiphong and the Suez Canal during the mid-1970s. Ironically, six examples of this model were also exported to Iran before the Shah's fall from power.

Further versions of the original twin-engine Sea Stallion include the CH-53G which was acquired by the West German army during the 1970s (most of the 112 machines obtained being manufactured by VFW-Fokker at Speyer), whilst the HH-53H is essentially an updated HH-53C with forward-looking infra-red, terrain-following radar and other equipment intended to bestow genuine night/all-weather capability, a shortcoming of the original rescue derivatives. Eight HH-53Hs are at present in use, these all being conversions of HH-53Bs and HH-53Cs.

More recently, the three-engine H-53E Super Stallion variant has begun to join US Navy and US Marine Corps units in quantity. Noteworthy features of this model include a seven-bladed main rotor and an unusual canted tail rotor pylon, whilst the greatly increased power permits operations at maximum weights of the order of 31752 kg (70,000 lb).

Go-ahead for the H-53E was given in May 1973 in the form of a contract to construct two prototype specimens, and the first of these made its maiden flight at the beginning of March 1974, only to be lost in a ground accident soon afterwards. Much of the following test programme was accomplished by two pre-production examples during the latter half of the 1970s, and it was not until 1981 that the new model began to enter operational service in its CH-53E form.

Present planning anticipates the procurement of up to 160 examples of the H-53E Super Stallion for US Navy and US Marine Corps units, this total including a number of MH-53Es for mine clearance duties.

635 NAVY
630 NAVY

Two of the RH-53Ds used in Operation 'Eagle Claw', still in their Navy colours to avoid compromising the purpose of their presence on board USS Nimitz. *Assault helicopters in desert camouflage might have attracted unwelcome attention.*

USA

Sikorsky CH-54 Tarhe

Now largely relegated to second-line service with the US Army, the **Sikorsky CH-54 Tarhe** evolved in response to a late 1950s requirement for a heavy-lift helicopter. Although the use of cargo hooks to lift heavy and bulky loads was a feature of the design, the Tarhe was also intended to straddle interchangeable pods in much the same way as the Mil Mi-10 does, and the resulting helicopter was particularly bizarre in appearance.

First flown in prototype form in May 1962, the type was evaluated by the US Army at Fort Benning in Georgia and proved sufficiently promising to warrant the placing of a production order for what was, by US Army standards, a relatively small quantity. Against this background, the parent company went ahead with the design of external containers for troop transport, field hospital support, anti-submarine warfare, mine-sweeping and heavy-lift operations, but these ambitious concepts met with little success, the only such pod being built taking the form of a universal type which could be employed in some of the aforementioned functions.

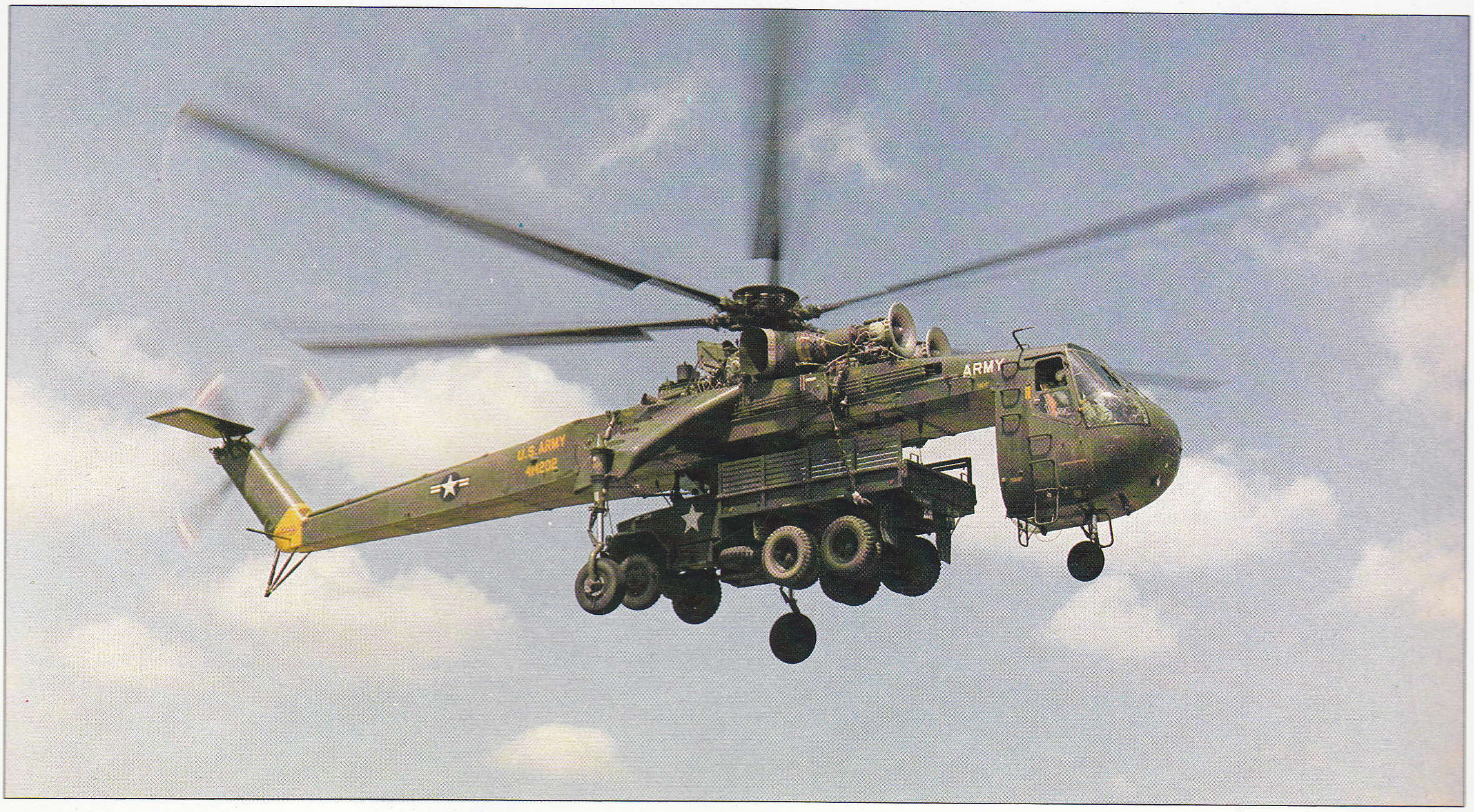
Almost inevitably, the type was deployed to Vietnam and it did perform well there, being instrumental in the recovery of no less than 380 aircraft and helicopters as well as facilitating rapid movement of bulldozers, graders and, on occasion, armoured fighting vehicles.

The evolutionary process eventually resulted in the appearance of the **CH-54B** derivative, this being fitted with more powerful engines, an uprated gearbox, a high-lift rotor blade, twin mainwheel landing gear members and an improved flight-control system, whilst the opportunity was also taken to strengthen the basic structure. Once again, the quantity acquired was small, deliveries beginning in 1969, most of those produced being deployed to Europe.

As far as is known, no example of the CH-54 remains in front-line service with the US Army today, those that were operated having given way to the Chinook several years ago.

Specification

Sikorsky CH-54A Tarhe
Type: heavy-lift 'flying crane' helicopter
Armament: none
Powerplant: two Pratt & Whitney T73-P-1 turboshafts each rated at 4,500 shp (3357 kW)
Performance: maximum speed at sea level 203 km/h (126 mph); maximum cruising speed 169 km/h (105 mph); service ceiling 2475 m (9,000 ft); range with maximum fuel and reserves 370 km (230 miles)
Weights: empty 8724 kg (19,234 lb); maximum take-off 19050 kg (42,000 lb)
Dimensions: main rotor diameter 21.95 m (72 ft 0 in); length, rotors turning 26.98 m (88 ft 6 in); height 7.75 m (25 ft 5 in)



The Sikorsky CH-54 Tarhe has now been largely replaced in service by the CH-47 Chinook. It was designed as a flying crane and to carry large, special-purpose pods under its fuselage, but these were never widely used.

USA

Sikorsky UH-60 Black Hawk

Although the Bell UH-1 Iroquois was and still is a fine helicopter, US Army requirements for the 1980s and beyond were such that it became clear at the start of the 1970s that the 'Huey' would eventually need replacement. So, in August 1972, after studying several proposals from industry, the US Army chose the Boeing Vertol and Sikorsky candidates for a competitive evaluation, a project which was undertaken during 1976 and which resulted in the **Sikorsky UH-60A Black Hawk** being adjudged the winner. An announcement to this effect was made on 23 December 1976, production of an initial batch of 15 getting under way in late 1977, and it is expected that these will prove to be the forerunners of well over 1,000 similar machines.

Deliveries to the US Army began late in 1978 and the type has since been widely deployed with US Army combat formations in both the USA and, more recently, Europe. Although originally conceived under the generic title UTTAS (Utility Tactical Transport Aircraft System), the UH-60A is in fact seen primarily as an assault helicopter and is therefore an extremely rugged machine, being able to withstand direct hits of armour-piercing rounds up to 7.62 mm (0.3 in) calibre in the fuselage. With accommodation for a crew of three and 11 fully-equipped troops, the Black Hawk is fitted with an external cargo hook with a capacity of 3629 kg (8,000 lb), whilst it can also operate in the casualty evacuation role, removal of cabin seats permitting up to four stretchers to be carried. Armament capability is at present limited to a pair of 7.62-mm (0.3-in) machine-guns firing from opened side doors, but provision also exists for chaff and flares to be dispensed.

Other proposals for the US Army have included the **EH-60A** electronic countermeasures variant and the **EH-60B** SOTAS (Stand-Off Target Acquisition System) model, both of which have flown in prototype form although there is some doubt as to whether they will be proceeded with, the latter apparently being plagued by numerous problems.

Somewhat more successful is the **SH-60B Seahawk** for the US Navy, this arising from that service's LAMPS (Light Airborne Multi-Purpose System) Mk III requirement for a seagoing helicopter to serve aboard surface combatant vessels in the anti-submarine warfare/anti-ship missile defence roles. Testing of this model began in December 1979, production examples having recently begun to reach fleet units for crew training purposes. The **HH-60D** has been ordered as the USAF's next-generation rescue helicopter.

Specification

Sikorsky UH-60A Black Hawk
Type: assault helicopter
Armament: two 7.62-mm (0.3-in) machine-guns
Powerplant: two General Electric T700-GE-700 turboshafts each rated at 1,543 shp (1150 kW)
Performance: maximum speed at sea level 296 km/h (184 mph); maximum cruising speed 272 km/h (169 mph); service ceiling 5790 m (19,000 ft); range at maximum take-off weight with 30-minute reserves 600 km (373 miles)
Weights: empty 4944 kg (10,900 lb); mission take-off 7462 kg (16,450 lb); maximum take-off 9185 kg (20,250 lb)
Dimensions: main rotor diameter 16.36 m (53 ft 8 in); length, rotors turning 19.76 m (64 ft 10 in); height 5.13 m (16 ft 10 in); main rotor disc area 210.05 m^2 (2,261 sq ft)

Assault on Grenada

The US invasion of Grenada in October 1983 was spearheaded by airborne troops. US Marines were landed from a variety of assault helicopters to secure the international airport, while Army Rangers dropped by parachute and were landed from helicopters to secure the incomplete new airport. Further use of helicopters was made during operations to flush out and neutralize Cuban troops in the hills. A number of American helicopters, including UH-60 Black Hawks and CH-47 Chinooks, were lost during the operation.

A Sikorsky UH-60 on Grenada. UH-60s are thought to have been heavily used in the invasion of the island, and a small number are known to have been lost.

The most recent major military endeavour calling for the extensive use of helicopters was the invasion of Grenada by a predominantly US force on 26 October 1983. As is usual, this operation was spearheaded by the US Marines.

In the initial stages of the invasion, near simultaneous landings were accomplished on the east coast near to Pearls airport and at Point Salines (the site of the contentious new airport) about 500 US Marines and 300 Caribbean troops seizing the former whilst 1,000 US Army Rangers dealt with the latter.

The landing adjacent to Pearls airport appears to have been tackled in typical US Marine fashion, essentially involving the use of amphibious craft and vehicles operating from the amphibious assault ship USS *Guam* and depositing a sizable contingent of troops on the beach. However, it is almost certain that helicopters also played a major part in the overall assault plan, probably depositing small company-sized numbers of troops at or close to key points. Certainly, TV coverage of subsequent events on the island provided firm evidence of the presence of the Boeing Vertol CH-46 Sea Knight, which is the principal US Marine assault helicopter, and it is known that several US Marine Corps Bell UH-1Ns were also in the vicinity. It seems that the US Marines did their job well, securing the airport quickly and thus permitting it to be used as a staging point for a further 1,000 troops airlifted in aboard a number of Lockheed C-130s from Barbados later on the same day.

In distinct contrast, US Army Ranger forces were dropped by parachute or flown in by helicopter, these units being tasked with seizing the as-yet incomplete new airport. Unlike the US Marines, the Rangers met with stiff opposition, there being a substantial number of Cuban soldiers and manual workers in the vicinity of the new airport, and these very quickly surrounded one of the nearby campus sites where several hundred American students resided. This in turn necessitated what was essentially a second seaborne invasion by the US Marines with the objective of surrounding the Cuban forces. Although this was successful, it was not until the afternoon of the second day that the students were finally rescued and evacuated from Grenada by Military Airlift Command Lockheed C-141 StarLifters which took them to Charleston, South Carolina.

Subsequently, many Cubans succeeded in evading capture and took to the nearby hills, it then being necessary for the US forces to undertake what might best be described as 'search and destroy' operations to quell the remaining resistance. This phase of the invasion and occupation seems to have taken several days to complete and, once again, may well have relied heavily on the use of helicopters, both to enhance mobility and to flush out enemy soldiers. Again, contemporary TV films showed several US Army Sikorsky UH-60A Black Hawk helicopters whilst all this was going on, and it is known that a small number of these were lost before the situation finally stabilized.

By the end of October, no less than 6,000 US troops were present on Grenada but with fighting at an end the process of withdrawal had begun in a small way, some of the Rangers and US Marines involved in the initial assault having already been returned to their original bases in the USA.

This mixed group of assault helicopters on the deck of USS Guam lying off Grenada includes an RH-53 Sea Stallion, a CH-46 Sea Knight and two Bell UH-1s.

USA

Bell UH-1 Iroquois

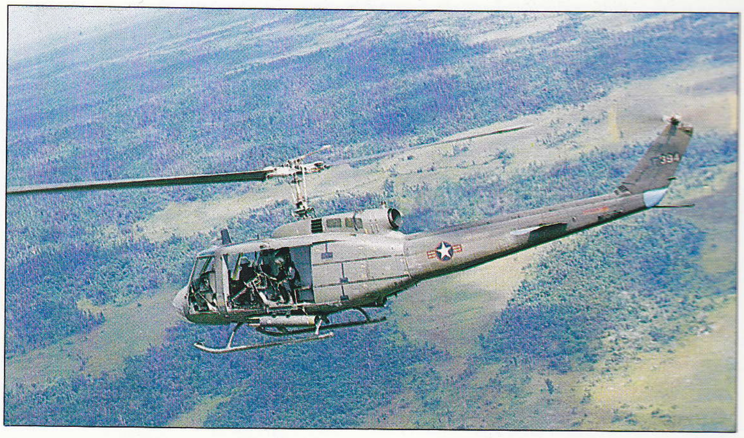
Probably best known for its exploits during the Vietnam War, the **Bell Model 204/205** series earned a justifiable reputation as a true workhorse in that conflict, being employed in a multiplicity of missions ranging from troop transport through casualty evacuation and liaison to more offensive applications as a gunship in search-and-destroy and riverine operations. As a by-product of its extensive use by all elements of the US armed forces, it became the most successful turbine-powered helicopter of its day and, indeed, subsequent derivatives based on the original **XH-40** prototype and **UH-1 Iroquois** production model are still in quantity production today, almost 30 years after it first flew in prototype form.

In service with approximately 60 air arms throughout the world, variants of the **'Huey'** have been produced by the parent company at Fort Worth, by Agusta in Italy, by Fuji in Japan, by AIDC in Taiwan, by Dornier in West Germany and, most recently, by the People's Republic of China. Over the same period, the gross operating weight has virtually trebled although overall size and appearance has changed relatively little.

Major production variants for the US armed forces include the **UH-1B, UH-1D** and **UH-1H** of the US Army; the **UH-1F, HH-1H** and **UH-1N** for the US Air Force; and the **UH-1E, HH-1K, TH/UH-1L** and **UH-1N** for the US Navy and US Marine Corps. Examples of most of these models were also produced in substantial amounts for export markets.

Armament and payload capability varied considerably between early- and late-production machines, but the UH-1H model of the US Army usually carries a couple of 7.62-mm (0.3-in) machine-guns adjacent to and fired from the main cabin. In addition to the pilot, up to 14 troops could also be accommodated, alternative configurations permitting carriage of up to six stretchers or 1814 kg (4,000 lb) of cargo. In later variants this figure is almost doubled.

Although now being supplanted in US Army service by the Sikorsky UH-60A, there is little doubt that the UH-1 will contine to form an important part of the US Army's aviation components for many years to come, whilst with later variants still in quantity production it is clear that the saga of the 'Huey' still has a long time to run.



A Bell UH-1 over Vietnam. This one is armed with rocket pods and has had its doors removed to allow a greater field of fire for its two 7.62-mm (0.3-in) machine-guns.

Specification

Bell UH-1H

Type: utility helicopter

Armament: usually two 7.62-mm (0.3-in) machine-guns

Powerplant: one Avco Lycoming T53-L-13 turboshaft rated at 1,400 shp (1044 kW)

Performance: maximum and cruising speeds 204 km/h (127 mph); range with maximum fuel 512 km (318 miles)

Weights: empty 2362 kg (5,210 lb); maximum take-off 4309 kg (9,500 lb)

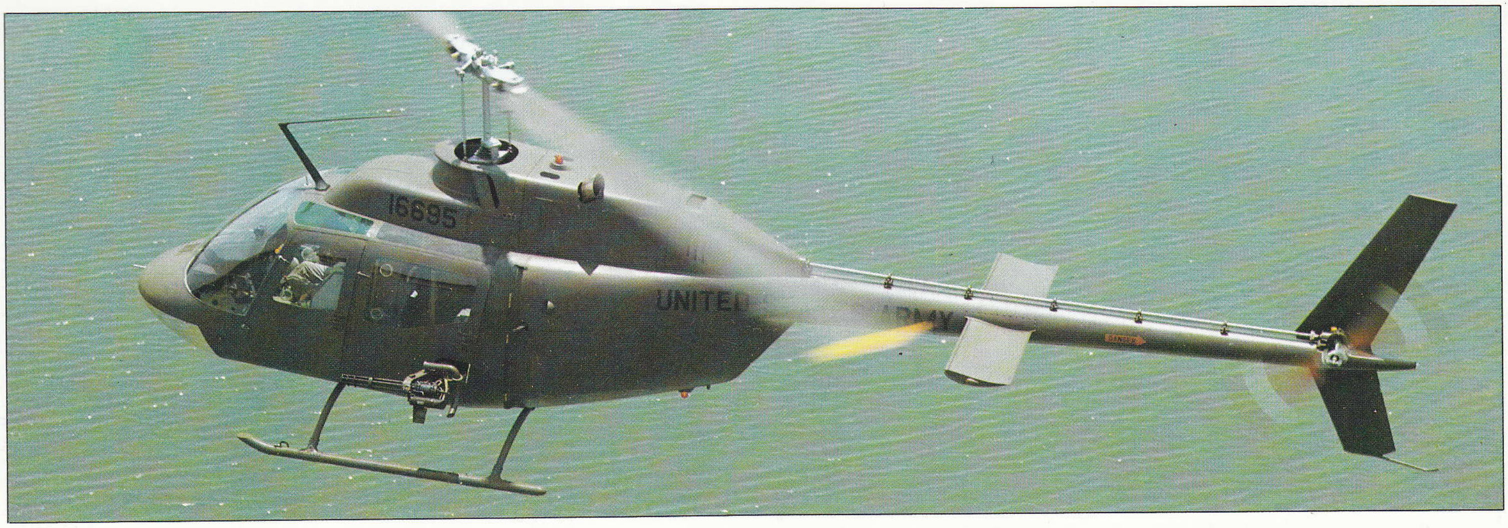
Dimensions: main rotor diameter 14.63 m (48 ft 0 in); length, rotor stowed fore and aft, 17.61 m (57 ft 9½ in); height 4.42 in (14 ft 6 in); main rotor disc area 168.1 m^2 (1,809.6 sq ft)

American infantrymen leap from a hovering Bell UH-1 during the Vietnam war. The assault helicopter won its spurs in Vietnam, giving ordinary soldiers a previously undreamed-of degree of mobility.

EADHUNTERS
39

USA

Bell OH-58 Kiowa



The Bell Kiowa is used by the US Army as an unarmed light observation and scout helicopter, although it does have an assault role in some smaller air forces.

Arising from a 1962 requirement for a new US Army LOH (Light Observation Helicopter), the type which eventually became the **Bell OH-58 Kiowa** in fact enjoyed a rather chequered early development history, losing out in the competition to the Hughes OH-6A Cayuse in a quite intense evaluation programme which also involved a Hiller submission.

Although the **Model 206** was not selected by the US Army, company confidence in the machine was particularly high and the design was quickly evolved into the **Model 206A JetRanger**, a type which went on to achieve considerable success in the civilian and export military markets and which is still being built today, albeit in much improved form.

The failure by Hughes in the mid-1960s to contain OH-6 costs and achieve the desired production rate eventually led to the LOH contest being re-opened during 1967, and it was a case of second time lucky for Bell, whose Model 206A emerged as the winner during March 1968. The reward was a contract for no less than 2,200 examples, all of which had been delivered by 1973.

Differing from its civilian counterpart by virtue of a larger-diameter main rotor, military avionics and a few detail changes, the OH-58A Kiowa, as the type became known, began to enter service with US Army units in May 1969 and was quickly deployed operationally, reaching combat units in South Vietnam within four months. Since then, it has seen service with US Army elements throughout the world and it is still a most important asset, normally operating in conjunction with AH-1 HueyCobra gunships as a scout helicopter.

Although not normally armed, the Kiowa has been tested with a variety of weapons and US Army examples can carry the XM27 Minigun. More recently, a substantial number have been re-engined and brought to **OH-58C** standard, other more visible indications of this change being the provision of infra red-suppressed exhaust nozzles, flat glass canopies to cut down reflection and wire cutters above and below the cockpit canopy.

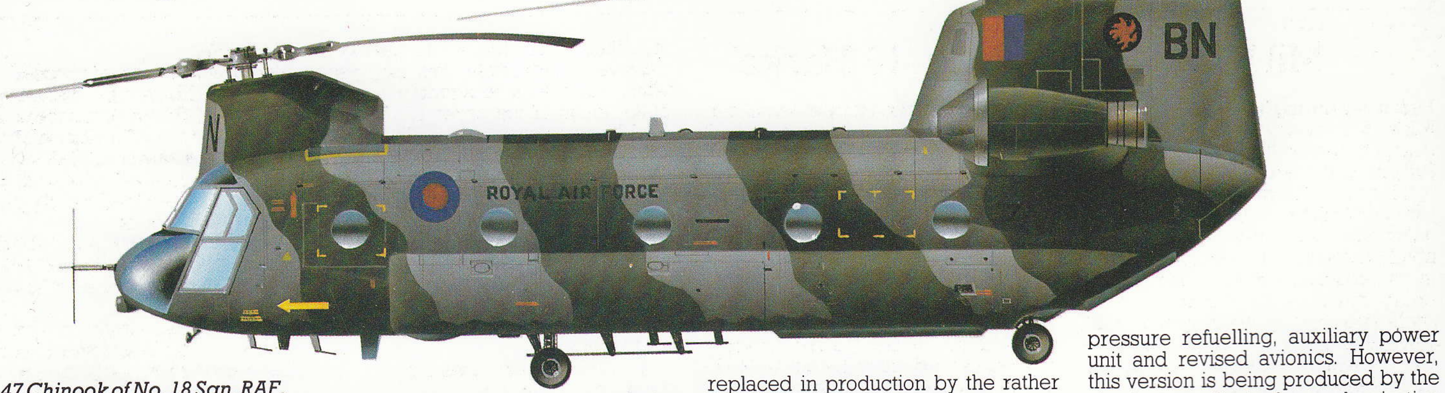
In addition to those examples operated by the US Army, variants of the basic Bell 206 also serve with the US Navy, Australia, Austria, Brazil, Canada, Chile, Iran, Italy, Spain, Sweden, Thailand, Turkey, United Arab Emirates and Venezuela amongst other countries.

Specification
Bell OH-58A Kiowa

Type: light observation/scout helicopter
Armament: none usually
Powerplant: one Allison T63-A-700 turboshaft rated at 317 shp (237 kW)
Performance: maximum speed at sea level 222 km/h (138 mph); cruising speed 188 km/h (117 mph); maximum range at sea level with 10 per cent reserves 481 km (299 miles)
Weights: empty 664 kg (1,464 lb); maximum take-off 1361 kg (3,000 lb)
Dimensions: main rotor diameter 10.7 mm (35 ft 4 in); length, rotors turning 12.47 m (40 ft 11 in); height 2.91 m (9 ft 6½ in); main rotor disc area 91.1 m^2 (980.5 sq ft)

USA

Boeing Vertol CH-47 Chinook



A CH-47 Chinook of No. 18 Sqn, RAF. The one RAF Chinook not destroyed in the sinking of the Atlantic Conveyor *proved to be of immense value during the Falklands war.*

Evolution of the **Boeing Vertol CH-47 Chinook** can be traced back to the late 1950s, when the US Army began to search for a turbine-powered medium transport helicopter capable of all-weather operation in virtually all types of climatic conditions. Of the several proposals submitted in response, the **Boeing Vertol Model 114** was adjudged most suitable, and this led to a contract for five prototype specimens in mid-1959.

First flown in prototype form on 21 September 1961, the Chinook began to enter service with the US Army just over a year later and quickly began to compile an impressive record, being deployed to Vietnam soon after US involvement in that conflict began to escalate. Capable of airlifting up to 40 troops, the CH-47 also proved of great value in airlifting supplies to the numerous garrisons which lay dotted around South Vietnam, whilst it was also frequently used to recover downed aircraft and helicopters and for the evacuation of casualties and refugees.

The initial **CH-47A** model was soon replaced in production by the rather more powerful **CH-47B**, but it was the **CH-47C** which was the definitive Chinook, this flying for the first time in October 1967 and entering service early in the following year. Once again, considerably more powerful engines were fitted, this model also having a strengthened transmission system and additional fuel capacity.

Further studies aimed at improving the Chinook's already impressive capabilities still further led eventually to the **CH-47D**, this incorporating revised electrical systems, glassfibre rotor blades, modular hydraulic systems, triple cargo hook, advanced flight-control systems, single-point pressure refuelling, auxiliary power unit and revised avionics. However, this version is being produced by the simple expedient of a modernization programme involving surviving CH-47As, CH-47Bs and CH-47Cs, a programme which began in 1979 with the conversion of three **YCH-47D** prototypes for trials work. Production-configured CH-47Ds began to join the US Army during 1983.

Variants of the Chinook have also met with some success on the export market, other operators including Argentina, Australia, Canada, Iran, Italy, Libya, Spain, Thailand and the United Kingdom, whilst it should also be noted that the type is produced under licence by Elicotteri Meridionali in Italy.

Specification

Boeing Vertol CH-47C Chinook

Type: medium transport/assault helicopter
Armament: none
Powerplant: two Avco Lycoming T55-L-11A turboshafts each rated at 3,750 shp (2796 kW)
Performance: maximum speed 304 km/h (189 mph); service ceiling 4570 m (15,000 ft); mission radius with 3294-kg (7,262-lb) payload 185 km (115 miles)
Weights: empty 9351 kg (20,616 lb); loaded 14,969 kg (33,000 lb); maximum take-off 20,866 kg (46,000 lb)
Dimensions: rotor diameter, each 18.29 m (60 ft 0 in); length, rotors turning 30.18 m (99 ft 0 in); fuselage length 15.54 m (50 ft 0 in); height 5.66 m (18 ft 7 in); rotor disc area, total 525.34 m^2 (5,654.9 sq ft)

One of 12 Boeing Vertol Chinooks of the Spanish army. The Chinook has been widely exported and is built under licence in Italy. It also saw service in Vietnam.

USSR

Mil Mi-6 'Hook' and Mi-10 'Harke'

First flown during September 1957, the **Mil Mi-6 'Hook'** was the first Soviet helicopter to rely on turbine power and is still one of the largest flying machines of this type in the world. Arising from a joint civil/military need for a heavy lift helicopter, the Mi-6 possesses the ability to carry light armoured vehicles in its capacious cabin (direct access being provided by means of clam-shell-type loading doors at the rear) whilst it also employs large fixed stub wings to alleviate loads on the rotor to a quite substantial degree when cruising. A further benefit bestowed by these wings is the fact that the Mi-6 may employ STOL techniques, permitting it to get airborne with a greater payload than it can lift vertically. As far as payload is concerned, the normal load is limited to around 12000 kg (26,455 lb) but, like most modern helicopters, it can also carry external cargo although in such instances the limit imposed is about 9000 kg (19,840 lb). Alternatively, approximately 70 troops can be carried, but it is unlikely that the type would be employed near the forward battle zones, its large size and limited manoeuvrability being likely to make it an attractive and vulnerable target.

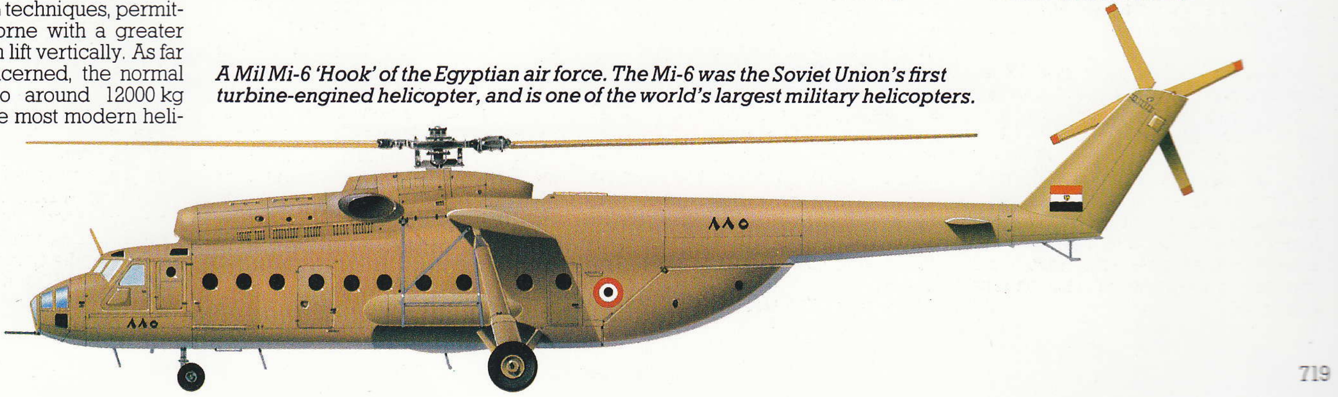
In addition to the basic Mi-6, two flying crane derivatives are known to have appeared, these being the **Mi-10** and the **Mi-10K**. Both are known by the NATO reporting name **'Harke'** although there are a number of noteworthy differences, the Mi-10 having a massive quadricycle landing gear which enables it to straddle and lift bulky loads of the order of 15000 kg (33,069 lb) while the Mi-10K has a much shorter and more conventional landing gear with an aft-facing crew station beneath the nose, from which a member of the crew monitors loading and unloading operations. Both the Mi-10 and Mi-10K can carry up to 28 passengers internally.

Specification

Mil Mi-6 'Hook'

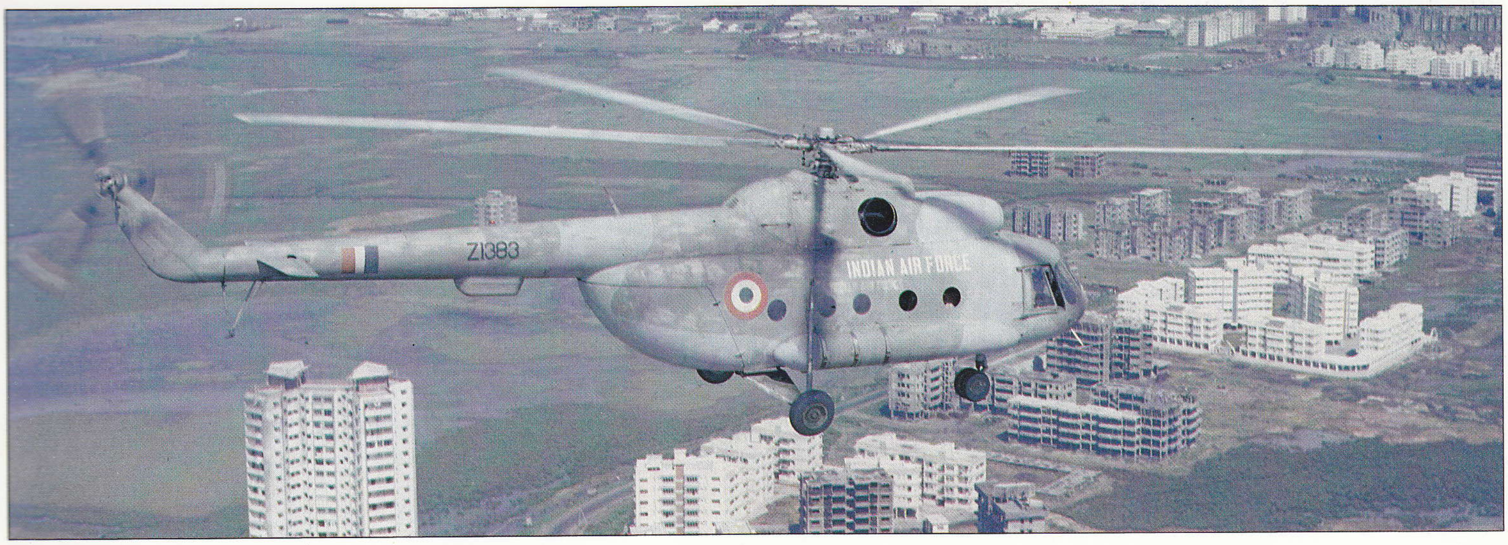
Type: heavy transport helicopter
Armament: none
Powerplant: two Soloviev D-25V turboshafts each rated at 5,500 shp (4101 kW)
Performance: maximum speed 300 km/h (186 mph); cruising sped 250 km/h (155 mph); service ceiling at maximum take-off weight 4400 m (14,435 ft); range with 12000-kg (26,455-lb) payload 200 km (124 miles); range with 4000-kg (8,818-lb) payload 1000 km (621 miles)
Weights: empty 27240 kg (60,055 lb); normal take-off 40500 kg (89,286 lb); maximum vertical take-off 42500 kg (93,700 lb)
Dimensions: main rotor diameter 35.00 m (114 ft 10 in); fuselage length 33.18 m (108 ft 10½ in); wing span 15.30 m (50 ft 2½ in); height 9.17 m (30 ft 1 in); main rotor disc area 962.1 m^2 (10,356.4 sq ft)

A Mil Mi-6 'Hook' of the Egyptian air force. The Mi-6 was the Soviet Union's first turbine-engined helicopter, and is one of the world's largest military helicopters.



USSR

Mil Mi-8 'Hip'



A Mil Mi-8 'Hip' of No. 121 Sqn, Indian Air Force. Indian Mi-8s are frequently armed with rocket pods and have largely replaced the fixed-wing C-47 Dakota in Indian service, as well as being used for offshore oil support missions.

Widely used by the Soviet air force and its Warsaw Pact allies, the **Mil Mi-8 'Hip'** began life as a logical turbine-powered adaptation of the earlier Mi-4 'Hound' although the degree of commonality which exists between the production configured 'Hip' and its predecessors is virtually non-existent.

First flown in prototype form during 1961, the Mi-8 initially appeared with a four-bladed rotor driven by a single Soloviev turboshaft engine, this being superseded on the second prototype by the now-standard twin-engine installation. About two years later, the original rotor assembly was supplanted by a five-bladed type and it was in this guise that the 'Hip' eventually entered production in about 1967.

Since then, well over 7,000 examples have been built and, in addition to Warsaw Pact nations, the 'Hip' also serves with the air arms of Afghanistan, Bangladesh, Egypt, Ethiopia, Finland, Iraq, North Korea, Pakistan, Peru, Somalia, South Yemen, Syria and Vietnam. In Soviet service the type is thought to be mainly assigned to tactical helicopter formations, and it can be assumed that it would therefore be mainly employed in assault-type operations.

Including the prototypes, at least six variants are known to have been built, those intended for assault and utility operations being the **'Hip-C'**, **'Hip-E'** and **'Hip-F'**. All feature rear-loading doors which permit carriage of 32 troops or 4000 kg (8,818 lb) of bulky or awkward items of cargo in the cabin, and all possess the ability to carry armament, the 'Hip-E' being particularly noteworthy in that it can operate with a 12.7-mm (0.5-in) nose-mounted gun, up to 192 rockets carried in no less than 12 external pods and four AT-2 'Swatter' anti-tank missiles. The latest assault version to be identified is the **'Hip-F'**, which appears to be aimed mainly at export markets and incorporates different armament in the shape of six AT-3 'Sagger' missiles. The **'Hip-D'** is yet another model in the family, this being optimized for electronic warfare tasks with extra aerials and large rectangular containers on external pylons. The **'Hip-G'**, **'Hip-J'** and **'Hip-K'** are communication-relay, ECM and advanced ECM versions respectively.

Specification

Mil Mi-8 'Hip-C'

Type: medium transport/assault helicopter

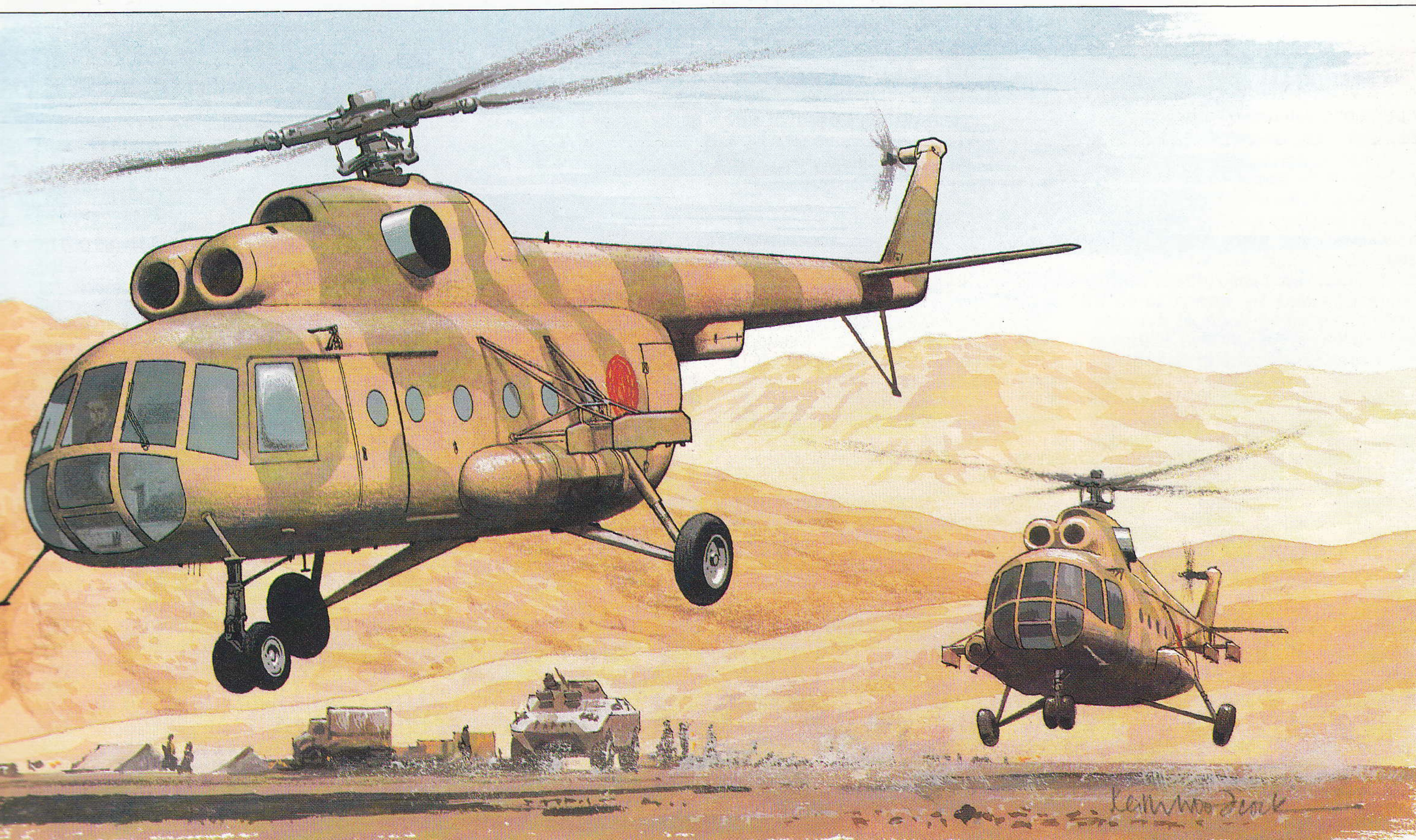
Armament: up to four rocket pods each with 32 57-mm (2.24 in) rockets and four AT-2 'Swatter' anti-tank missiles, plus one 12.7-mm (0.5-in) machine-gun

Powerplant: two Isotov TV-2-117A turboshafts each rated at 1,700 shp (1267 kW)

Performance: maximum speed 260 km/h (161 mph); cruising speed 200 km/h (124 mph); hover ceiling 4500 km (14,765 ft); range with 2950-kg (6,504-lb) payload 425 km (264 miles)

Weights: empty 7160 kg (15,785 lb); maximum take-off (VTO mode) 12020 kg (26,499 lb)

Dimensions: main rotor diameter 21.29 m (69 ft 10½ in); fuselage length 18.31 m (60 ft 1 in); height 5.60 m (18 ft 4½ in); main rotor disc area 356.000 m^2 (3,832 sq ft)



A Mil Mi-8 in the markings of the Afghan air force. Afghan Mi-8s are usually flown by Soviet 'advisers', and Afghan markings may often be carried by Soviet Mi-8s operating in Afghanistan.

Armed Forces of the World

US Navy

Part 3

Submarine forces

To counter the growing threat posed by cruise SSMs launched from submerged Soviet nuclear submarines, it is customary to attach one or more SSNs to an attack group. With sensors and speed unaffected by weather conditions, these are far and away the best ASW platforms; despite the target figure of 100 hulls, there will never be enough of them to meet likely demand.

Only a trio of rather elderly diesel-electric boats remain and, when these are shortly stricken, the force will be all-nuclear. As with other major fleets, there are two main groups of boats, those deploying strategic missiles (SSBN) and those designed for attack purposes (SSN). The latter already carry the encapsulated Harpoon SSM and will be getting Tomahawk in the second half of the 1980s so, more correctly, they will need to be recategorized SSGN.

With the 10 original SSBNs of the 'George Washington' and 'Ethan Allen' classes being stripped of their strategic missile-launching capacity, the Polaris A3 (still deployed by the British) has been phased out. Backbone of the current force are the 31 'Lafayette' class boats, some with Poseidon C3 and some converted to Trident C4. Entering service are the considerably delayed 'Ohio' class boats, also with the Trident C4, 24 to a hull.

As the Poseidons have a range of 'only' about 4500 km (2,800 miles), they are best used to target Soviet peripheral areas as, to reach the heartland, they would have to be launched from the deep oceans, leaving the submarines open to increasingly effective Soviet anti-submarine forces. To avoid long transits, and thus increase availability, forward operational bases for SSBNs still exist in Guam and Scotland, that in Spain having been closed. The Trident C4 was deliberately configured to the same envelope as that of the Poseidon to allow an updating programme to be undertaken: with an 8000-km (5,000-mile) range they allow SSBNs to work from safer waters.

Indeed, when it is remembered that a circle of 8000-km (5,000-mile) radius has over three times the area of one of 4500-km (2,800-mile) radius it will be obvious how much more difficult anti-SSBN operations will prove to be.

Later 'Ohio' class boats will get the Trident D5, the earlier boats of the class then being retrofitted. There will be no question of uprating the 'Lafayettes' as the Trident D5 is too long to be accommodated in their hulls. As the Trident D5 will have an estimated 10500-km (6,525-mile) range, the SSBNs will be able to remain virtually in home waters, in areas where they can more easily be safeguarded from Soviet countermeasures. What proportion of the existing fleet is involved in SSBN direct support is not known, but this will obviously be reduced, releasing more units for other purposes.

In order to accommodate these large missiles, the 'Ohio' class boats have statistics that are both impressive and alarming. They can hardly be dived safely in a great proportion of continental shelf waters and, no matter how quiet, offer other signatures by virtue of their bulk. With a length of the same order as that of a nuclear cruiser, they must surely represent the ultimate on the grounds of prudence alone. It will be interesting to watch development of the submarine-launched Tomahawk, for if it can achieve its hoped-for accuracies at over 2000 km (1,245 miles), each SSN will be equipped with the beginnings of a new generation of strategic weapon.

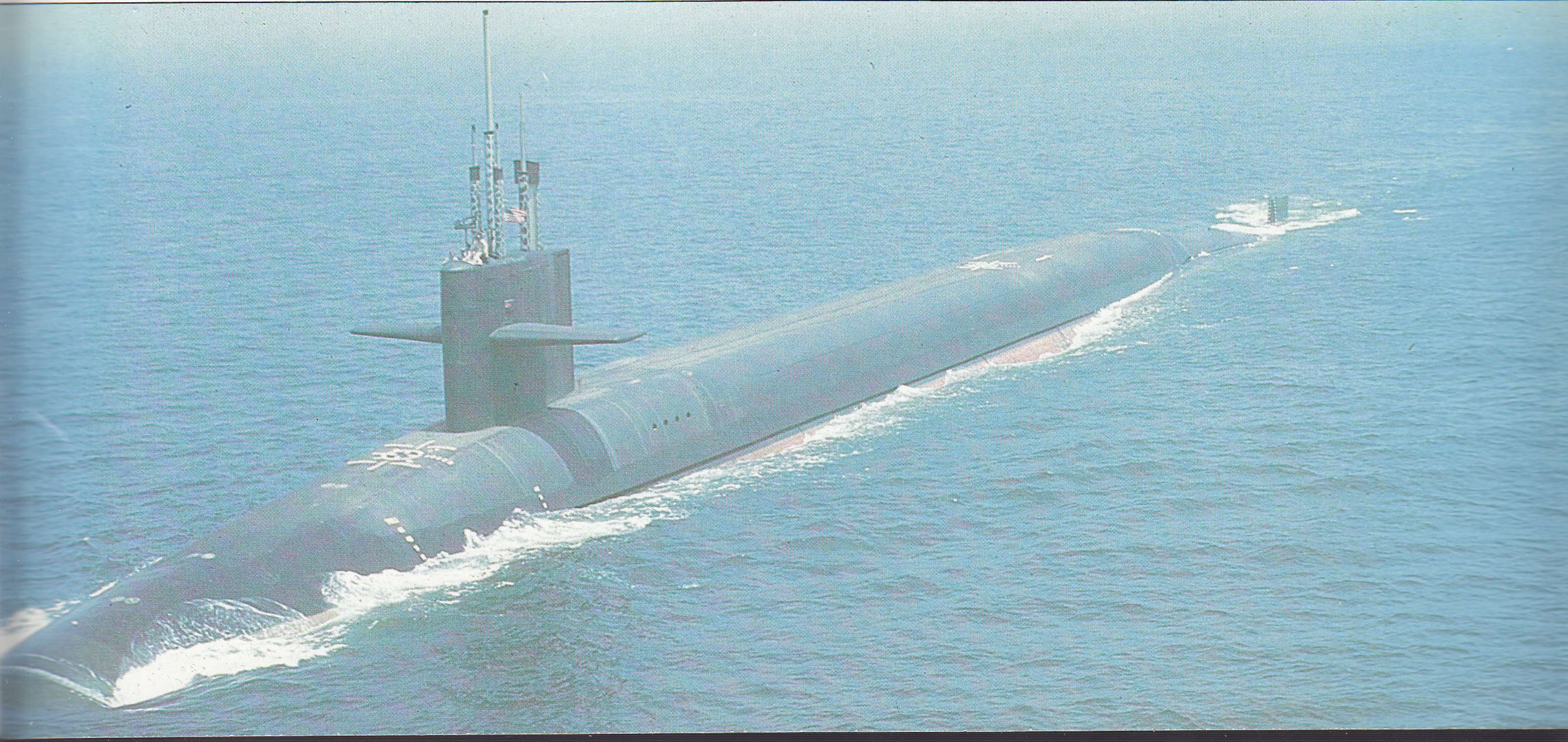
Attack submarines (SSNs) like the SSBNs are 'hot-war' vessels, lacking much ability to scale their response to meet a particular threat. Their defence is based on concealment; their threat is latent, and to make a deliberate appearance so as to threaten overtly is to cast aside their main advantage.

American submarine design reserves the space right forward for primary sonars. As a result, the tubes are in a rather constricted site amidships, restricting their number to six or, more commonly, four. In spite of this a wide range of weapons can be carried and launched from the same tubes: against shorter-range submarine targets the Mk 37 torpedo, and for longer-range submarines or surface ship targets the Mk 48 torpedo, reputedly good out to about 50 km (31 miles) with a combination of wire-guidance and terminal homing, combined with a high degree of onboard electronic intelligence. The SUBROC is a submarine-launched ballistic weapon which has a nuclear warhead; it can 'sanitize' a considerable area to guarantee the killing of a target as important as an enemy SSBN. Now somewhat elderly, it is due to be phased out in favour of the new ASWSOW (ASW Stand-off Weapon), currently in an advanced development stage. Surface ships can be targeted at nearly 100 km (62 miles) by the encapsulated Harpoon and, as mentioned above, submarine-launched Tomahawk is under development. Finally, the same tubes can be employed for minelaying.

Oldest of current front-line SSNs are the 'Skipjack' class boats of 1959-61, which married nuclear propulsion to the high-speed hull resulting from the Albacore experiments. Their somewhat exaggerated form inhibits their sensor and armament fits, and the follow-on 'Permit' and 'Sturgeon' classes had easier lines. Running to some 50 hulls, this group forms the bulk of the US Navy's SSN strength. Despite experiments in advanced machinery, including cooling by liquid metals or natural convection, contra-rotating propellers and turbo-electric drives, all still feature the standard combination of pressurized-water-cooled (PWC) reactors upstream of a conventional steam turbine plant driving a single centreline screw.

Much controversy surrounds the currently-building 'Los Angeles' (SSN 688) class, whose installed power has doubled to meet the challenge from recent Soviet equivalents, reputed to be the world's fastest. This power increase has been purchased at the expense of length, nearly 110 m (361 ft) compared with the 'Sturgeon' class boats' 89 m (292 ft). In comparison, the Soviet 'Victor II' and 'Victor III' classes are about 100 m (328 ft), the British 'Swiftsure' class 83 m (272 ft) and the French 'Rubis' class only 72 m (236 ft). While the 'Los Angeles' class boats are highly capable, they are getting vulnerably large and, at about $600 million per boat, very expensive.

Latest in the line of US strategic missile submarines, the 'Ohio' class will eventually be armed with 24 long-range Trident D5 missiles. This will enable the submarines to operate close to home waters, where their bulk and detectability would be no handicap.



HIGH
VOLTAGE

Sonar technicians man their underway watch stations at the sonar console aboard the 'Los Angeles' class nuclear-powered attack submarine* La Jolla *(SSN 701). These submarines are highly capable, but critics consider them too large and therefore vulnerable to detection by opposing ASW forces.

In time of war, one of the SSNs' main tasks would be to penetrate Soviet 'citadel' areas, where the Soviet SSBNs would be deployed as a bargaining element. They would endeavour to prevent older enemy SSBNs breaking out into the open oceans, needing to attack not only these but also the submarine and surface forces supporting them. They would be needed to supplement the escort screens of carrier battle groups, and also to cover the vital resupply convoys on the transatlantic route, which would be fiercely contested by Soviet submarine forces. Such merchant traffic still operated by the enemy would need to be stopped, but most Soviet high-quality mercantile tonnage would be operating as naval auxiliaries, and the currently rapidly increasing Soviet capacity for amphibious warfare promises further targets for interdiction. The US Navy's target is 100 SSNs: even if realized, this total will be none too many.

Specialized fields

While having less anti-submarine bias than European navies, the US Navy has very considerable potential in the field. General surveillance is still based on the well established SOSUS lines, strings of sensors spaced at strategic points, usually in continental-shelf waters. Each vessel crossing such a line has its acoustic signature monitored, analysed and compared with references stored in a library. This process is automatic and very rapid and, should a signal look interesting, an aircraft such as a Lockheed P-3 Orion will be brought in to pinpoint the contact. Its 17-hour endurance enables the Orion to linger, dropping active and passive sonobuoys, interrogating and processing the data on board or exchanging it with surface ships. Further aids to detection are the magnetic anomaly detector (MAD) equipment, which responds to the large metallic mass of a submerged submarine, and forward-looking infra-red (FLIR) gear, which can detect the warm plume of air exhausted by a snorting 'conventional' boat. Carrierborne Lockheed S-3 Vikings have a similar, if more basic, fit. Both carry a range of anti-submarine ordnance, including nuclear depth bombs if appropriate.

SOSUS itself, though essentially a passive system, can be 'armed' with advanced weapons such as CAPTOR, an encapsulated anti-submarine homing torpedo release by the correct signature. Being geared to shallow-water applications, SOSUS needs supplementing in the deep oceans and this, initially, will take the form of simple 'Stalwart' class trawler-type ships (AGOS) which will operate slowly with long towed arrays known as TACTAS (Tactical Towed Array Sonar). As these are deployed at some considerable distance behind the ship and at chosen depths, their potential for detection is very high. Specialist ships are required because of the size of the winch assemblies, though smaller versions with shorter tows can be deployed by frigates. These seem likely to replace the earlier variable-depth sonar (VDS) installations, which were introduced to counter the 'ducting' effects of the layers of water of varying temperature and salinity, which refract and distort acoustic propagation in unpredictable ways.

American hull-borne sonars are much larger than their British equivalents as they work at much lower frequencies; this confers a theoretically greater range, but only at the expense of size and complexity. The bulky transducer assemblies are housed in very large bulbs at the forefoot. These are partly flooded, reducing both water noise and pitch acceleration in the ship herself but, in head seas, they can emerge and slam abominably if the ship is driven too hard. Indeed, in northern water in winter it is unlikely that a frigate can even use a hull sonar for more than 50 per cent of the time, whereas a towed array, once streamed, can operate in quite severe conditions.

As in submarine practice, surface ships normally use sonar in the passive mode, necessarily at low speed to reduce self-induced noise. Passive sets will indicate bearing but not range, which requires either a bearing from another ship to give a 'fix' or, if this is not available, a quick burst of energy from an active set.

Other specialist sonars in the American inventory include upward-looking sets for submarines navigating beneath ice, and side/oblique-scanning sets for the detection and classification of submerged objects, such as mines.

Mine countermeasures is one field where the Americans have been inactive for far too long in view of the vulnerability of their shallow approaches and the known mine warfare expertise of the Soviets. Only a handful of the obsolete 53-m (174-ft) MSOs remain in service; built as a result of the Korean War, these ocean minesweepers incorporate the means of countering mine technology of the 1950s and, even though modernized, have nothing of the capabilities of current European MCMVs, built from glass-reinforced plastic (GRP). Modern mines have considerable inbuilt electronic intelligence, so that they can be made to react to various types and combinations of signature, to count stimuli and ignore a set number, and even to discriminate between genuine targets and sweeping gear. The only sure way to deal with them is to detect by sonar, to identify and then to destroy by countermining with a charge dropped either by a miniature remotely-controlled submersible or by divers.

A range of floating sleds, supporting countermeasures gear, has been developed by the Americans for towing behind Sikorsky RH-53D helicopters. Considerable success was claimed for them at both Haiphong and Suez, but it is difficult to see how they can deal with any remotely intelligent mine.

At long last, a new class of MCM is being built with the USS *Avenger* (MCM 1) as lead ship. The programme was delayed by the need to trim a previously over-ambitious design.

As far as mine technology is concerned, the US Navy has a wide range of types available, including the already-mentioned CAPTOR and an advanced weapon, named Quickstrike, under development. Most laying would be undertaken by submarines or aircraft but, acknowledging that the former would be in extremely short supply and the latter can lay notoriously inaccurately, the infrequent exercises in surface ship laying might well be stepped up with advantage.